

THE GENUS *EUDENDRIUM* (HYDROZOA: HYDROIDA) FROM AUSTRALIA

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ABSTRACT: Seventeen species of *Eudendrium*, including ten newly described, are reported from Australia. All known Australian material of *Eudendrium* has been examined in this study and past misidentifications rectified. Five species: *E. ramosum* (Linnaeus, 1758); *E. racemosum* Cavolini, 1785; *E. capillare* Alder, 1856; *E. carneum* Clarke, 1882; and, *E. glomeratum*, Picard, 1951 are new records for Australia. Two tropical species, *E. kirkpatricki* n. sp. and *E. infundibuliforme* Kirkpatrick, 1890, are recorded from Torres Strait and Papua New Guinea. The former also ranges from the north of Western Australia to the Great Barrier Reef while the latter is now recorded from several places on the Great Barrier Reef. *Eudendrium terranova* n. sp., formerly recorded from northern New Zealand as *E. novaezelandiae* Marktanner-Turnerretseher, 1890, is now reported from southern Australia. *Eudendrium pusillum*, von Lendenfeld, 1885 is synonymised in *E. generale* von Lendenfeld, 1885 and the range of *E. generale* is now reduced to temperate south-eastern Australia.

The importance of the endome in classification of the Eudendriidae is discussed and the genus *Eudendrium* is redefined by including features of the endome in the diagnosis. A key is given to the Australian species of *Eudendrium*.

This paper extends knowledge of the distribution of the *Eudendrium* fauna around Australia. Most of the species are recorded from the eastern and south-eastern coastline; only four are known from Western Australia and none from the Northern Territory, Tasmania or the Great Australian Bight. Present records indicate a highly endemic *Eudendrium* fauna with species confined mainly to one or two marine biogeographic provinces. Only *E. aylingae* n. sp. is recorded from three provinces, ranging from cool temperate to tropical waters.

Previous records of *Eudendrium* from Australia include: an unidentified species (Bale 1884); *Eudendrium generale* von Lendenfeld, 1885; *E. pusillum* von Lendenfeld, 1885 (= *E. lendenfeldi* Briggs, 1922 and *E. indopacificum* Stechow, 1923); *E. capillare* Alder, 1856; *E. album* Nutting, 1898; and, *E. infundibuliforme* Kirkpatrick, 1890. Species originally described from Australia include: *E. generale*, recorded from the south coast (von Lendenfeld 1885, Bale 1919) and the tropical north in Torres Strait (Kirkpatrick 1890, Pennycuik 1959); and, *E. pusillum*, from the temperate eastern coastline (von Lendenfeld 1885, Ritchie 1911) and from tropical north-western Australia (Jäderholm 1916) *Eudendrium infundibuliforme* has been recorded only once, from Torres Strait (Kirkpatrick 1890, Pennycuik 1959); *E. capillare* was reported from the tropical east coast (Pennycuik 1959) and the subtropical west coast (Stechow 1925); and, *E. album*, from the tropical east coast (Pennycuik 1959).

In the course of the author's subtidal ecological studies in southern Australia it became necessary to distinguish between some commonly-occurring species of *Eudendrium*. This requirement led to a critical reappraisal of type material, examination of all known Australian material, some New Zealand specimens, and material held in the personal collection of the author. This investigation has revealed misidentification of some species, for example, *E. generale* of Kirkpatrick (1890), Bale (1919) and Ritchie (1910), and *E. capillare* of Stechow (1925) and Pennycuik (1959). Re-examination

of von Lendenfeld's type material of *E. generale* and *E. pusillum* leads to the conclusion that the latter (and thus, *E. lendenfeldi* Briggs, 1922 and *E. indopacificum* Stechow, 1923) are synonyms of *E. generale*.

On the basis of this review, the family Eudendriidae in Australia now comprises 17 species, ten of which are here described as new. It is accepted here that some of the newly-described species, particularly those of the "*E. capillare*" group, whose taxonomy is in need of critical world-wide revision, might eventually be synonymised with that species. *Eudendrium generale* of Kirkpatrick (1890) and *E. capillare* of Stechow (1925), are considered to be a new species with a wide distribution through the tropical north of Australia. *Eudendrium generale* of Bale (1919) proves to be an undescribed species, while *E. infundibuliforme* Kirkpatrick, 1890, an easily-identifiable hydroid, is now shown to have a wide distribution from Papua New Guinea through the length of the Great Barrier Reef. Earlier records of *E. capillare* have been found to be incorrect and the species is now doubtfully recorded from only two localities in eastern Australia. Species known from outside the Australian region include: *E. ramosum* (Linnaeus, 1758); *E. racemosum* Cavolini, 1785; *E. capillare* Alder, 1856; *E. carneum* Clarke, 1882; and, *E. glomeratum* Picard, 1951. With the exception of the latter, all are well known, widely-distributed species, while *E. capillare* is near cosmopolitan. The Australian record of *E. glomeratum* is the first for that species outside the European region.

The search for identity of Australian species also led to the comparison of the type material of *Eudendrium novaezelandiae* Marktanner-Turneretscher, 1890 from New Zealand with the "Terra Nova" specimen doubtfully assigned by Totton (1930) to this species. Totton's specimen, which is identical with abundant material collected by the author in Bass Strait, Victoria, is not *E. novaezelandiae*, but a species here described as new. A redescription of *E. novaezelandiae* will be given elsewhere (Watson in prep.).

The family Eudendriidae has long been one of the more diagnostically troublesome of the Athecata. Many authors (c.g. Nutting 1898, Totton 1930, Vervoort 1959, 1972, Millard 1975) have acknowledged problems in distinguishing between the species of *Eudendrium* because of similarity of colony morphology throughout the genus. Fraser (1912) correctly pointed out that branching and colony height are not specifically constant features; nevertheless, he considered sexual differences to be adequate to distinguish between his North American species. Unfortunately, the reproductive structures show remarkably little morphological variation throughout the genus. The male gonophores in various species are one to four chambered, arising in a verticil below a hydranth which may remain fully developed, or show varying degrees of atrophication. Similarly, the female gonophores are borne on a blastostyle which may show some, or no atrophication of the tentacles, or may simply have a reduction in the number of tentacles present. The female spadix is usually unbranched and is resorbed as the single egg approaches maturity. A few species (such as *E. carneum* Clarke, 1882; *E. racemosum* Cavolini, 1785; *E. ritchei* Millard, 1975; and, *E. motzkossowskiae* Picard, 1951) have a branched female spadix and are more readily identifiable than most species of *Eudendrium*. Thus, considered alone, the reproductive structures can give no more than a guide to the identity of species. However, when considered in conjunction with features of the endome, they usually provide a good guide for identification of species (Werner 1965).

THE CNIDOME IN CLASSIFICATION

The systematic importance of the endome of *Eudendrium* has received surprisingly little attention. Early workers noted the presence of nematocysts in the hydranth—the "thread cells", "gland cells" and "nettle ring" (Hineks 1868, Allman 1871, von Lendenfeld 1885, Kirkpatrick 1890), and nematocyst pads associated with the gonophores (Bale 1919). Light (1913) described, and gave dimensions of, the nematocysts in *E. griffini* (= *Myrionema griffini*) from the Philippines. Broch (1916) noted, but did not explore the diagnostic value of, the "rod-shaped" nematocysts in the tentacles, and the different, much larger "basal capsules" in the hydranth of *E. wrighti* Hartlaub, 1905. Weill's (1934) classic study on the morphology, physiology and development of nematocysts, including those of *E. racemosum*, provide a foundation that has been follow-

ed by Picard (1951, 1955), Werner (1965) and Millard (1975) for identification of species of *Eudendrium*.

Details of the endome are known for about one-third of the known species of *Eudendrium* (Bouillon pers. comm., Mergner pers. comm., Weill 1934, Itô & Inoue 1962, Millard & Bouillon 1974, Cooke 1975, Millard 1975, Kubota 1976, Rösler 1978). Millard (1975) used kind and shape of nematocysts, in conjunction with other colony characters, to key out southern African species of *Eudendrium*.

In the present study, the nematocysts and the endome are used as a primary systematic tool for distinguishing between the Australian species of *Eudendrium*. The classification of nematocysts by Weill (1934), Werner (1965) and Mariscal (1974), adopted here, provides a satisfactory, if somewhat detailed, basis for identification. Nonetheless, problems of specific identity sometimes still occur, due to the difficulty of correctly identifying incompletely-discharged or undischarged nematocysts.

Members of the genus *Eudendrium* are related in the possession of small microbasal euryteles in the tentacles. The pyriform capsule of the tentacular nematocysts may range in size from 5 to 10 μm in length and 2 to 4 μm in width. The shaft is usually 1 to 2 μm shorter than the capsule, and bears a few distal spines. The shaft discharges forward in the long axis of the capsule and the thread is usually fine and moderately long. The tentacular nematocysts of some Australian species have a thicker thread with fine, but distinct, bristles. Because of their similarity throughout the genus, the tentacular microbasal euryteles are not especially useful in identification of species.

When nematocysts of more than one size or kind are present, they are collectively designated as the endome. The supplementary nematocysts of the endome never reside in the tentacles but are situated around the hypostome or on the body of the hydranth. In some species they are scattered on the spadix of the female gonophore or aggregated into distal pads on the gonophores of either sex. With few exceptions, the larger microbasal euryteles situated around the hypostome discharge sideways, probably to allow the thread to eject laterally across the mouth. The shaft itself may also be penetrant and capable of restraining prey, since the distal end is often heavily armed with bristles and spines. This armature is often distinctive enough to be specifically diagnostic. The armature of some species, e.g. *E. capillare*, and several species described here as new, comprises only small, forwardly-discharging microbasal euryteles similar to those in the tentacles. Laboratory observations on living material of a species possessing only small microbasal euryteles showed that the hydranths have a very reactive hypostome suggesting that this species may compensate for a weak armature by placing more reliance upon rapid engulfment, rather than entanglement, of prey.

Five of the species recorded here have only microbasal euryteles in the endome; eleven species have two kinds, and one species has three kinds of

nematocysts. Although the cnidome is usually constant in the kind and abundance of its constituent nematocysts to be diagnostically useful, some species noted in this study, for example, *E. infundibuliforme* Kirkpatrick, 1890, and *E. generale* von Lendenfeld, 1885 possess "fugitive" nematocysts which may be common to rare, or possibly, absent altogether. Loss of nematocysts without replacement, as shown by *E. generale*, may lead to problems in identification, since sterile specimens of this species, lacking supplementary microbasic euryteles, can be easily confused with *E. capillare*. It is possible that gradual attrition of the cnidome through ageing of the colony may not be especially rare among the Eudendriidae. Further critical study of this phenomenon is warranted in view of the taxonomic implications.

Five species (30% of the Australian *Eudendrium* fauna) have a cnidome including large microbasic euryteles additional to the small tentacular microbasic euryteles. Seven species have kinds of nematocysts other than microbasic euryteles. Five of these have heteronemes and two species have haplonemes. One of the heteronemes is identified here as a microbasic p-mastigophore, in a species newly described from southern Australia. Although the other heteronemes are here classified as macrobasic euryteles, identification is somewhat doubtful in cases where there are no discharged nematocysts in the material available for examination.

Apart from variations in relative abundance, the size of the nematocysts comprising the cnidome may also vary within and between colonies of the one species, as well as over the geographic range of the species. Regional differences in size of nematocysts are exemplified by the difference in size of the larger microbasic euryteles of *E. ramosum* being 50% greater in Australian specimens than in those from southern Africa (Millard 1975) and the Mediterranean Sea (Mergner pers. comm.). Despite such variations in absolute size of nematocysts, the length to width ratio of the capsule (Kubota 1976) is usually relatively constant. This ratio has therefore been adopted in this study as an aid to identification of species.

Although requiring further study to determine the limits of variability of form and size within each species, nematocyst morphology will become an increasingly useful diagnostic tool in future taxonomy of many athecate groups. Critical world revision of the Eudendriidae using electron microscopy of nematocysts after the manner demonstrated by Mergner and Wedler (1977) and Östman (1979) will provide a better understanding of the variability of the cnidome, and hence, of species.

EXAMINATION OF THE CNIDOME

Whenever possible, fresh, living material collected using SCUBA was used in this study. Specimens were placed individually in plastic bags and sealed underwater to reduce the likelihood of contamination by foreign nematocysts.

Good to excellent discharge of nematocysts could usually be achieved on mounting a living specimen directly into Berlese medium (Mahoney 1973). Similarly, specimens preserved in alcohol may be discharged satisfactorily in this, or other aqueous mountants, but discharge cannot be induced in formalin-preserved material. Drying and re-hydrating and other methods using various reagents, such as dilute acids and alkalis (Yanagita & Wada 1953), were not always successful in discharging certain kinds of nematocysts, even in fresh material. Discharge of even the most resistant nematocysts can be achieved by immersion of the specimen in a dilute solution of domestic bleach (4% Cl₂ M/V) for 30–60 sec, washing in fresh water, then mounting directly into an aqueous medium. This treatment may, however, cause delicate threads to detach or even dissolve.

Russell (1938) has pointed out that confident diagnosis of nematocysts requires examination of an extensive range of material. It was found in the present study, that examination of several hydranths, hydranth pedicels and thin-walled parts of branches and gonophores, preferably from several colonies, was necessary for satisfactory examination of the cnidome. Specimens were first examined whole in the mountant to determine disposition of the nematocysts, then squashed for examination ($\times 1,000$, oil immersion lens, using phase contrast). To reduce inaccuracies in dimensions only nematocysts seen in full in lateral view were measured.

Migration of the cnidoblast has been studied in *Tubularia* (Hadzi 1907) and the mechanism of exchange in *Hydra* (Semal-Van Gansen 1951, Burnett & Lentz 1960). The only detailed observations on nematocyst migration in *Eudendrium* are by Mergner (1957) who examined this phenomenon in *E. racentosum*. The coenosarc of pedicels and branches of Eudendriidae often contain many undischarged nematocysts in transit between various parts of the colony. When the colony consists only of bare stems, as often occurs with moribund or poorly-preserved specimens, study of transitory nematocysts can provide a useful means of identification of species. Examination of nematocysts enclosed within the perisarc has the added advantage that adventitious nematocysts from other cnidarians are excluded, thus allowing more confident diagnosis.

REPRODUCTIVE STRUCTURES

Most descriptions of the reproductive structures of *Eudendrium* refer merely to presence or absence, or partial to complete atrophy of the tentacles of the hydranth or the blastostyle. Examination of the large amount of fertile material in the present collection shows that considerable information can be gained at the specific level by detailed investigation of the morphology of the blastostyle. For example, in some species there are no tentacles present on the blastostyle even at the earliest growth stage of the gonophores; in other species a full complement of tentacles may surround a fully-developed hydranth throughout maturation. In-

intermediate patterns, such as retention of normal tentacles with or without loss of the hypostome occur in some species, while others may show a reduction in the size or the number of tentacles present. Reduction in the number of tentacles often occurs through a process of selective atrophy or complete resorption of alternate tentacles (see electron micrograph of *E. ramosum* by Rösler 1978, Pl. 39, Fig. 2). Such strategies may have developed to relieve overcrowding of the hydranth in species which bear a large number of female gonophores on the body of the hydranth.

Wherever possible in this paper, the reproductive structures are described in detail, preferably from a growth series of living or freshly-preserved material.

MATERIAL

Type and other material examined in this study has originated from, or has been lodged in the British Museum (Natural History) (BM), the Queensland Museum (QMGL), the Australian Museum (AMG), the Museum of Victoria (MVF) and the Western Australian Museum (WAM). Some material is also held in the personal collection of the author.

SYSTEMATICS

Family EUDENDRIIDAE

The Family Eudendriidae comprises only two genera, *Eudendrium* and *Myrionema*. The latter is a rare genus, distinguished from *Eudendrium* by the large number of tentacles in several close whorls on the hydranth. It has been recorded once from Australia as *Myrionema amboinense* Pictet, 1893 by Briggs and Gardner (1931). The original definition of the genus *Eudendrium* by Ehrenberg (1834) has been changed by successive authors (Hincks 1868, Allman 1871, Hartlaub 1905, Mergner 1957, Naumov 1960, Millard 1975, Stepanjants 1979). It is here further modified by the additional description of the kind of nematocyst common to all species of the genus.

Genus *Eudendrium* Ehrenberg, 1834

DIAGNOSIS: Hydrocaulus invested with perisarc. Hydranths radially symmetrical with large hypostome and a whorl of filiform tentacles. Microbasic euryteles always present in tentacles; other kinds of nematocysts may be present in hydranth and gonophores. Gonophores, fixed sporosacs, borne on hydranth below tentacles. Reproductive hydranth often reduced to a blastostyle. Male gonophores single or in linear series. Young female gonophore a single egg encircled by a spadix.

KEY TO THE SPECIES OF *EUDENDRIUM* FROM AUSTRALIA

Numbers in brackets refer to the order in text and to the distribution map (Fig. 95).

1. Nematocysts comprising all microbasic euryteles. 2
- Cnidome includes nematocysts other than microbasic euryteles 11
2. Microbasic euryteles all of same size 4
- Microbasic euryteles not all of same size 3
3. Microbasic euryteles of two sizes present 8
- Microbasic euryteles of three sizes present *E. minutum* (1)
4. Colonies of medium size (to 100 mm height), stems fascicled, branching orderly 7
- Colonies small (to 25 mm height), stems unfascicled, irregularly branched 5
5. Mature male gonophore on hydranth with fully developed tentacles *E. pennycuikae* (2)
- Mature male gonophore on blastostyle entirely devoid of tentacles 6
6. Nematocyst pads present on gonophores of both sexes *E. nambuccense* (3)
- No nematocyst pads on gonophore. *E. capillare* (4)
7. Pedicel of hydranth indistinctly annulated *E. terranovae* (5)
- Pedicel of hydranth deeply corrugated throughout *E. corrugatum* (6)
8. Mature gonophores of one or both sexes on hydranth with full number of tentacles 9
- Mature gonophores of both sexes on blastostyle without tentacles 10
9. Mature gonophores of both sexes with tentacles reduced to stumps *E. ramosum* (7)
- Mature female gonophore on blastostyle without tentacles *E. kirpatricki* (8)
10. Supplementary nematocysts of cnidome with a few spines on shaft *E. generale* (9)
- Supplementary nematocysts of cnidome with numerous bristles on shaft *E. merulum* (10)
11. Cnidome with haplonemes 12
- Cnidome with heteronemes 13
12. Cnidome includes heterotrichous anisorhizas; mature female gonophore enclosed in a fenestrated capsule, *E. carneum* (11)
- Cnidome includes atrichous isorhizas; cnidophores sometimes present *E. racemosum* (12)
13. Cnidome includes macrobasic euryteles 14
- Cnidome includes nematocysts other than macrobasic euryteles: microbasic mastigophores present *E. balei* (13)
14. Colonies of moderate size, up to 80 mm in height. 16
- Colonies small, up to 12 mm in height 15
15. Macrobasic euryteles elongate, paddle-shaped, length-width ratio 3:1, shaft with overlapping spines, *E. aylingae* (14)
- Macrobasic euryteles oval in shape, length-width ratio 2:1, shaft very long *E. currumbense* (15)
16. Pedicel of hydranth expanding distally *E. infundibuliforme* (16)
- Pedicel of hydranth of same diameter throughout, nematocyst pads on lower body of hydranth *E. glomeratum* (17)

***Eudendrium minutum* n. sp.**

Figs 1-4

TYPE MATERIAL AND RECORD: Holotype MVF50520, one colony alcohol preserved, on dead stem of alcyonarian *Mopsea encrinura* (Lamarck), depth 12 m, Port Phillip Heads, Victoria, 38° 18' S, 144° 40' E; coll: J. E. Watson (SCUBA), 13/12/82.

DESCRIPTION OF HOLOTYPE: Colony sterile, comprising 15-20 stems arising from a tubular stolon wandering on surface of substrate. Stems up to 3 mm in height, unfasciated, slender, simple, or if branched, bearing 1-3 irregularly-spaced branches each with a terminal hydranth. Lower part of branched stems and simple stems deeply annulated with up to 10 spiral rings, branches with a few indefinite proximal annulations, those terminating in a hydranth frequently annulated throughout. Perisarc of stems moderately thick, becoming thinner distally. Hydranths small, with approximately 20 tentacles, hypostome large, open and annular (preserved material).

Nematocysts, microbasic euryteles of three sizes present:

—small microbasic euryteles, capsule elliptical, 7-8 × 3 μm, shaft 5-6 μm long, spines indistinguishable, thread rather thick (Fig. 2). Abundant in tentacles.

—large microbasic euryteles, capsule bean-shaped, 21-22 × 10-13 μm, shaft 13-19 μm long, thick, armed with spines, discharges sideways, thread thick, with spirals of very fine bristles (Fig. 3). Moderately common in hypostome.

—microbasic euryteles, slightly smaller, capsule elongate, paddle-shaped, 18-19 μm long, 7 μm wide, shaft 17-18 μm long with numerous spines on distal neck region and head, thread fine (Fig. 4). Abundant around hypostome.

MEASUREMENTS, mm: *Stem*, max. proximal width, 0.075; *Branch*, maximum length, 1.1; *Pedice*l, width below hydranth, 0.075-0.1; *Hydranth*, width below tentacles (preserved material), 0.24-0.25.

REMARKS: *Eudendrium minutum* is unusual in having three different kinds of microbasic eurytele comprising the cnidome. This characteristic, and the very small size of the colonies, clearly distinguish it from all other Australian species. Kubota (1976) also described a cnidome comprising microbasic euryteles of three sizes in *E. boreale* Yamada, 1954, from Japan. This species is, however, quite distinct from *E. minutum* in both size of colony and in its heavily corrugated branches. *Eudendrium minutum* is similar in height of stem and colony characters to *E. antarcticum* Stechow, 1921, *E. tenellum* Allman, 1877, *E. insigne* Hincks, 1868 and *E. irregulare* Fraser, 1922. None of these species have been reported from the Australian region, *E. antarcticum* having been recorded from South Africa (Millard 1957, 1975, Stechow 1921, 1925) while the other three species are recorded from Japan, the Indopacific and Pacific regions (Yamada 1954, Fraser 1937). The record of *E. insigne* from New Zealand (Ralph 1953) is doubtful (pers. obs.). The cnidome of none of these species is known with certainty.

Throughout the large sample of nematocysts of *E. minutum* examined, all the spines of the largest, sideways-discharging nematocysts appeared to be solid and thorn-like. While these may be of an unusual type, it is more likely that they have failed to extend fully at discharge. The site on the hypostome of the slightly smaller, forwardly-discharging microbasic euryteles is unusual. As far as is known (Millard 1975, Bouillon pers. comm., present study), all other large hypostomal microbasic euryteles discharge sideways across the mouth, presumably in order to maximise effectiveness in capture of prey.

Eudendrium minutum is a very small and delicate species found in sheltered oceanic habitat, in very strong current flow.

ETYMOLOGY: The specific name refers to the small size of the colonies.

***Eudendrium pennycuikae* n. sp.**

Figs 5-8

non *Eudendrium album* Nutting, 1896. Pennycuik, 1959: 167.

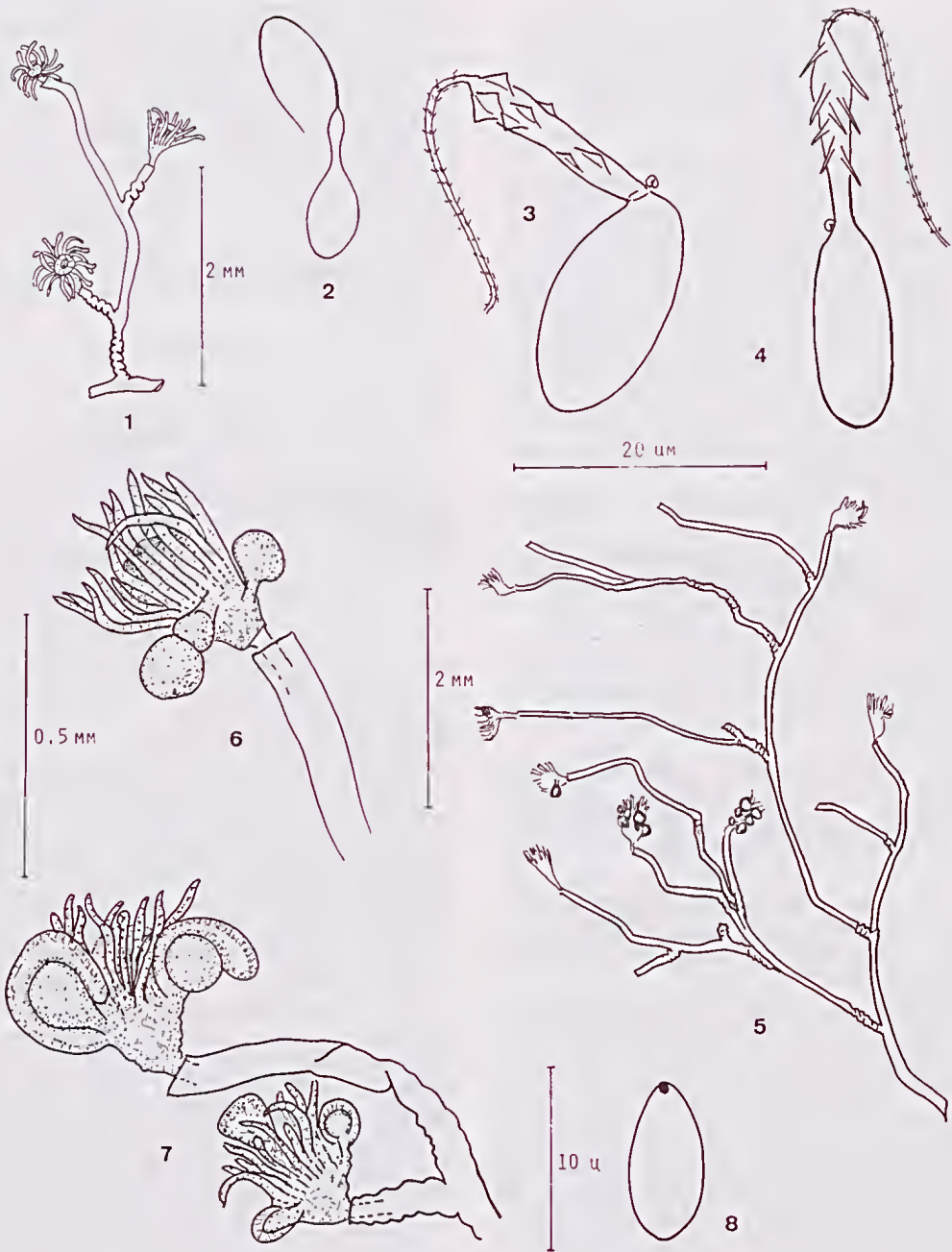
TYPE MATERIAL AND RECORD: Several colonies, alcohol preserved, on seagrass. 1 select as holotype a male colony, QMGL3267. Paratype: female colony, QMGL3268. All material trawled off Bundaberg, Queensland, 24° 52' S, 152° 48' E, Agassiz Trawl, 28 m, on *Halophila spinulosa* R. Brown (Aschers); coll: M. Blackburn, 14/9/1938.

DESCRIPTION FROM HOLOTYPE AND PARATYPE: Colonies comprising several stems, the largest 10 mm in height, arising from a tubular hydrorhiza wandering on the surface of the plant. Primary stems with up to 8 deep, proximal rings, no clearly-defined main stem, sparsely and irregularly branched, branches with 3-5 wrinkled annulations at origin, wrinkled or annulated at intervals throughout length. Hydranths small, slender, with a prominent hypostome (preserved material) surrounded by about 20 tentacles. Mature male gonophores bead-shaped, 2-chambered, up to 3 below a fully-developed hydranth. Female gonophores immature, with unbranched spadix, borne below a fully-developed hydranth; gonophores elongated with unbranched spadix, borne in groups of 3-5 below a fully-developed hydranth which is either shed at maturity or continues growth distally, leaving a few single gonophores scattered along the blastostyle. Nematocysts of only one kind present: small microbasic euryteles, capsule 5-8 × 3-4 μm, shaft 5 μm long, present in tentacles and body of hydranth, none discharged.

MEASUREMENTS, mm; *Stem*, max. diameter, 0.075; *Pedice*l, 0.066-0.08; *Hydranth* (preserved material), length, 0.26-0.40, diameter below tentacles, 0.17-0.27; *Female gonophore*, diameter, 0.15-0.20; *Male gonophore* diameter of distal chamber, 0.12-0.13.

COLOUR: Pennycuik (1959) gives no information on the colour of living specimens. Colour of preserved material, pale golden brown.

REMARKS: Pennycuik (1959) described, but did not figure, her specimens from Bundaberg, Queensland.



Figs 1-4—*Eudendrium minutum* n. sp. Drawn from holotype, Port Phillip Heads, Vic. 1, Whole stem. 2-4, Nematocysts, 2, Microbasic eurytele from tentacles. 3, Microbasic eurytele from hypostome, discharging sideways. 4, Microbasic eurytele from hypostome discharging in axis of capsule.

Figs 5-8—*Eudendrium pennycuikae* n. sp. 5, Whole stem, drawn from holotype, Bundaberg, Qd. 6, Hydranth with mature male gonophores, from holotype. 7, Hydranth with young female gonophores, from paratype. 8, Microbasic eurytele, undischarged, from tentacles.

Eudendrium pennycuikae compares very closely with *E. capillare* Alder, 1856 and *E. antarcticum* Stechow, 1921, especially in the possession of microbasic euryteles of only one size. I have compared Pennycuik's specimen with fertile material of *E. capillare* (BM1948.9.8.85, coll: E. T. Browne from Plymouth, U.K.) and the latter has a blastostyle with tightly-packed male gonophores and is entirely devoid of tentacles, similar to descriptions of *E. capillare* by Millard and Bouillon (1974) and Millard (1975). In contrast, the male gonophores of *E. pennycuikae* are borne on a fully-developed hydranth. Unfortunately, the paratype does not show a complete growth series of gonophores. It is likely that complete loss of the tentacles of the female blastostyle occurs near maturity.

Although the nematocysts of *E. pennycuikae* are not well preserved they are sufficiently clear to compare with a specimen of *E. album* [BM1948.9.8.83; coll: E. T. Browne, Plymouth, U.K. (no date)]. The nematocysts of this specimen, although undischarged, comprise tentacular microbasic euryteles, capsule $6.5 \times 3 \mu\text{m}$, and large bean-shaped ?macrobasic euryteles, $22-23 \mu\text{m} \times 9-11 \mu\text{m}$. Clearly, on the basis of this comparison, the Queensland material is not *E. album* as identified by Pennycuik (1959). Nevertheless, Bouillon (pers. comm.) considers that *E. album* has microbasic euryteles only. Such differences of opinion are indicative of the confusion surrounding the identity of even the supposedly better-known species of *Eudendrium*; it emphasises the need for critical review of the entire family.

ETYMOLOGY: This hydroid is named for Pamela Pennycuik who first recorded the species from Queensland.

Eudendrium nambuccense n. sp.

Figs 9-16

TYPE MATERIAL AND RECORDS: Holotype, MVF50508, one male colony, formalin preserved, Nambucca Heads, New South Wales, $30^{\circ} 40' \text{S}$, $153^{\circ} 0' \text{E}$, depth, 3 m on the mussel *Trichomya hirsuta* Lamarck; coll: J. E. Watson (SCUBA), 5/1/72.

OTHER MATERIAL: MVF50507, one female colony, formalin preserved, off Portsea, Victoria, $38^{\circ} 18' \text{S}$, $144^{\circ} 40' \text{E}$, depth, 12 m, on bryozoan; coll: J. E. Watson (SCUBA), 20/4/82.

DESCRIPTION OF HOLOTYPE: Colony luxuriant, comprising many stems arising from a tangled hydrorhiza on the surface of the mussel. Stems bushy, about 10 mm in height, unfasciated, irregularly and profusely branched. Perisarc of stems smooth and shining, becoming very thin and delicate distally. Primary stems ringed proximally, branches with up to 8 indistinct annulations at origin and obscurely ringed at intervals throughout their length. Hydranths small, terminal on branch, with 24-28 tentacles. A prominent ring of nematocysts ("nettle ring" of early authors) encircles the lower body of the hydranth. Male gonophores borne on lower region of colony, single-chambered, elliptical in shape when mature, each on a long stalk, in clusters of up to 15 on a cor-

rugated blastostyle. Blastostyle completely devoid of tentacles at all stages. Younger gonophores with a pronounced apical pad of nematocysts, lost at maturity. Nematocysts of only one kind present: small microbasic euryteles, capsule ranging in size from $5-9 \mu\text{m} \times 2-3.5 \mu\text{m}$, shaft $4-5 \mu\text{m}$, rather narrow with a small head armed with a few spines and a thick, ropy thread. The nematocysts fall into two fairly distinct groups within this size range, a smaller size in the tentacles and hydranth and larger ones on the gonophores.

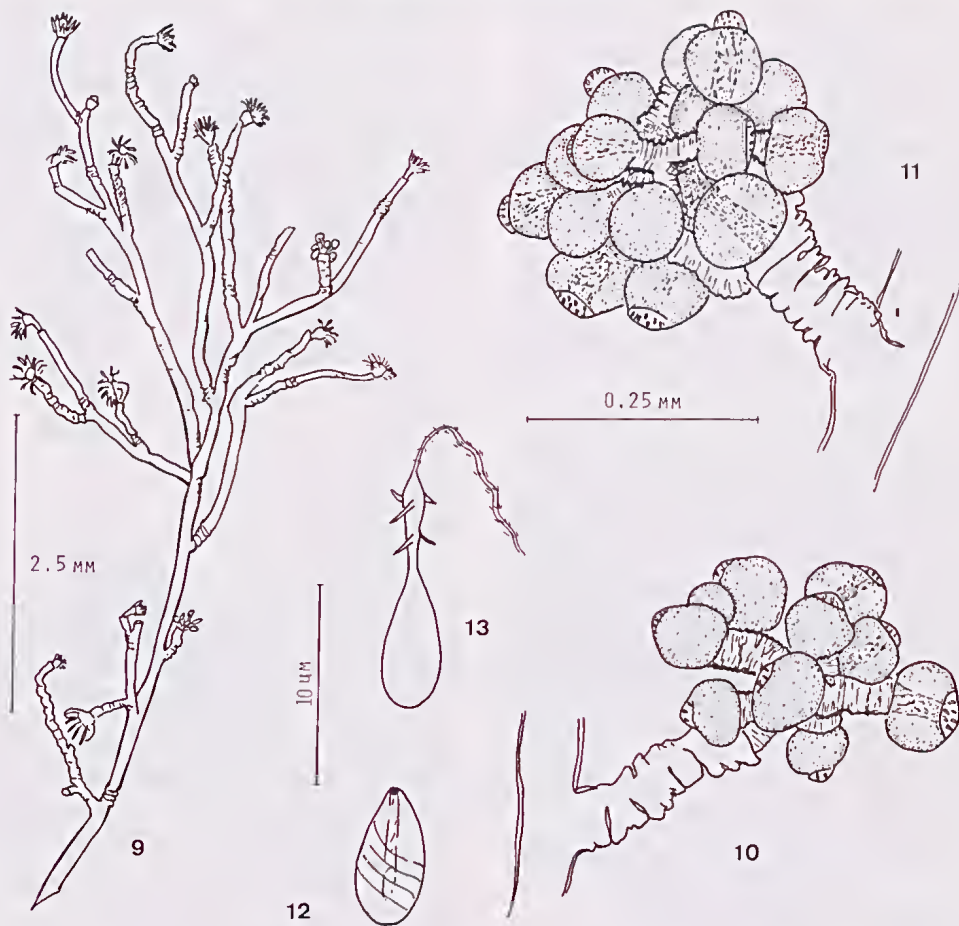
MEASUREMENTS, mm:	MVF50508	MVF50507
	Holotype	
Stem, maximum width	0.11	0.1
Distance between primary branches	0.3-0.8	
Width of pedicel below hydranth	0.06-0.08	0.05-0.08
Hydranth (preserved material) width below tentacles	0.1-0.18	0.15-0.24
Gonophore male, width distal chamber	0.06-0.08	
female, width mature		0.09-0.11

COLOUR: Lower stems brown, distal region creamy to colourless, colour of male not recorded.

OTHER MATERIAL: The female colony (MVF50507) from southern Australia comprises about 20 stems up to 15 mm in height. The gonophores are creamy coloured, pear-shaped, in tight clusters of 6-8 around hydranths on the lower part and mid-region of the colonies. Fertile hydranths with only half the usual number of tentacles, but these tentacles not atrophied; pedicel corrugated throughout. Spadix of female unbranched, with a conspicuous distal nematocyst pad, sometimes lost at maturity; mature gonophore enclosed in a very thick pellicle with roughened surface.

REMARKS: The nematocysts of the southern specimens overlap those of the type material in size, the smaller of the southern specimens being about the same size as the larger ones of the type. However, the length-width ratio of the capsule (Kubota 1976) remains constant at 2.5-2.6:1 over the geographic range. The larger nematocysts of both specimens are always associated with the nematocyst ring and gonophores. Since colonies of *Eudendrium* vary considerably in size and morphology with habitat and environmental conditions (pers. obs.), and the dimensions of nematocysts may also vary over the geographic range (Millard 1975, Kubota 1976, this study), the differences between the southern material and the type are not considered significant.

Eudendrium nambuccense is similar in many respects to the cosmopolitan *E. capillare* Alder, 1856, and may eventually prove to be a variant of that species. The chief differences between *E. nambuccense* and *E. capillare* as reported from the Pacific region and the southern hemisphere (Millard & Bouillon 1974, Millard 1975, Yamada 1959) are: the presence of a nematocyst ring on the hydranth and nematocyst pads on the immature gonophores of both sexes; the single-chambered male gonophore; and the reduction in number, but not



Figs 9-16—*Eudendrium nambuccense* n. sp. 9, Holotype, Nambucca Heads, N.S.W. 10, 11, Mature male gonophores with nematocyst pads. 12, 13, Nematocysts from tentacles of holotype. 12, Undischarged microbasic eurytele. 13, Microbasic eurytele, discharged. 14-16, Colony from Portsea, Vic.

size, of the tentacles of the female blastostyle of *E. nambuccense*. Although Broch (1916) reported an "accumulation of stinging cells distally" on the male gonophore of *E. capillare* from Greenland, apparently neither the female gonophores nor the hydranths of his specimens possessed aggregates of nematocysts. Mergner (pers. comm.) considers that the presence, or absence, of nematocyst pads is not necessarily specific to the identity of *E. capillare*. Several authors have described *E. capillare* as having a single kind of nematocyst ranging in length of capsule from 4-10 μm (Millard & Bouillon 1974, Millard 1975, Cooke 1975, Kubota 1976). None of these authors report a slight difference in size between the tentacular microbasic euryteles and those situated elsewhere on the hydranth and gonophores. While slight differences in size of nematocysts and presence or absence of nematocyst pads may not be individually important features at the

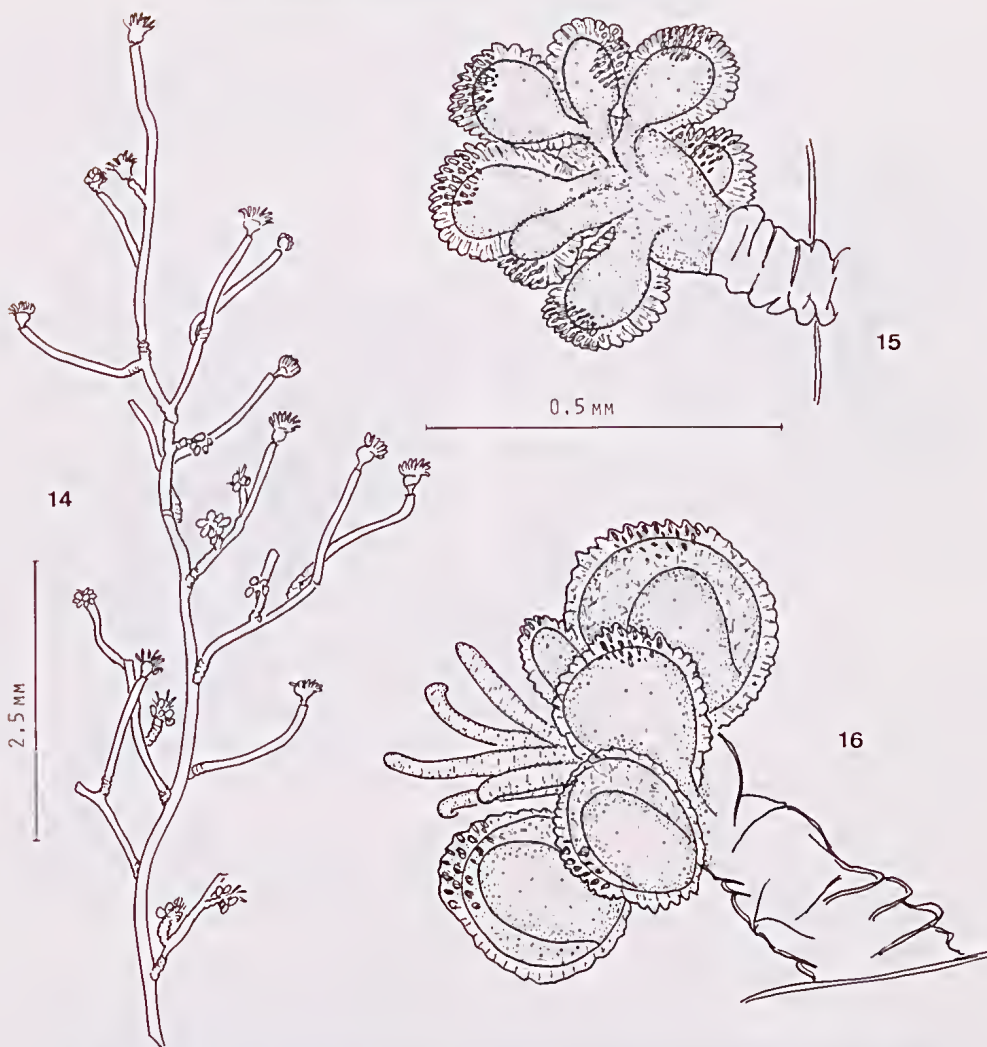
specific level, when considered together, they justify separation of the Australian material as a recognisable species, closely related to *E. capillare*.

ETYMOLOGY: The specific name refers to the type locality.

Eudendrium ?*capillare* Alder, 1856

Figs 17-19

Eudendrium capillare Alder, 1856: 355, Pl. 12, Figs. 9-12. Allman, 1864: 18; 1872: 335, Pl. 14, Figs. 1-3; 1876: 253. Van Beneden, 1866: 18, 50, 115. Hincks, 1868: 84, Pl. 14, Fig. 2. Weismann, 1883: 109, 218, Pls. 1, 2. Von Lendenfeld, 1885: 351. Thallwitz, 1885: 50. Bourne, 1890: 393. Kirkpatrick, 1890: 608. Levensen, 1893: 154. Hartlaub, 1894: 167. Marktanner-Turncretscher, 1895: 395. Nutting, 1896: 146; 1905: 939; 1927: 201. Bonnevie, 1898: 8;



14, Stem. 15, Young female gonophore, posterior view showing nematocyst pads, tentacles obscured. 16, Female gonophore in later stages of maturity.

1899: 50; 1901: 7. Billard, 1904a: 153; 1906: 70; 1907: 338; 1912: 462. Broeh, 1916: 62, Jäderholm, 1909: 11, 53, Pl. 3, Figs. 8, 9. Steehow, 1909: 29; 1913: 61, Figs. 15-17; 1919: 30, 31; 1923a: 80; 1923b: 4; 1925a: 520; 1927: 308. Vanhöffen, 1910: 290. Ritchie, 1910: 828. Fraser, 1911: 12, 24; 1912: 348, Fig. 6; 1914: 122; 1918: 18; 1937: 40; 1938: 18; 1948: 197. Kramp, 1914: 993. Bale, 1919: 335. Jarvis, 1922: 331. Leloup, 1934: 6. Vervoort, 1941: 193; 1946: 295; 1959: 218. Vannucei, 1954: 105. Pieard, 1955: 183. Yamada, 1959: 25. Naumov, 1960: 244, Fig. 132. Mammen, 1963: 57, Figs. 25, 26. Christiansen, 1972: 290. Calder, 1972: 226, Pl. 2, Fig. 6. Millard & Bouillon, 1974: 17, Figs. 3E-H. Cooke, 1975: 90, Pl. 1, Figs. 3, 4. Millard, 1975: 82, Fig. 27E-J. Rösler, 1978: 48. Hirohito, 1983: 10.

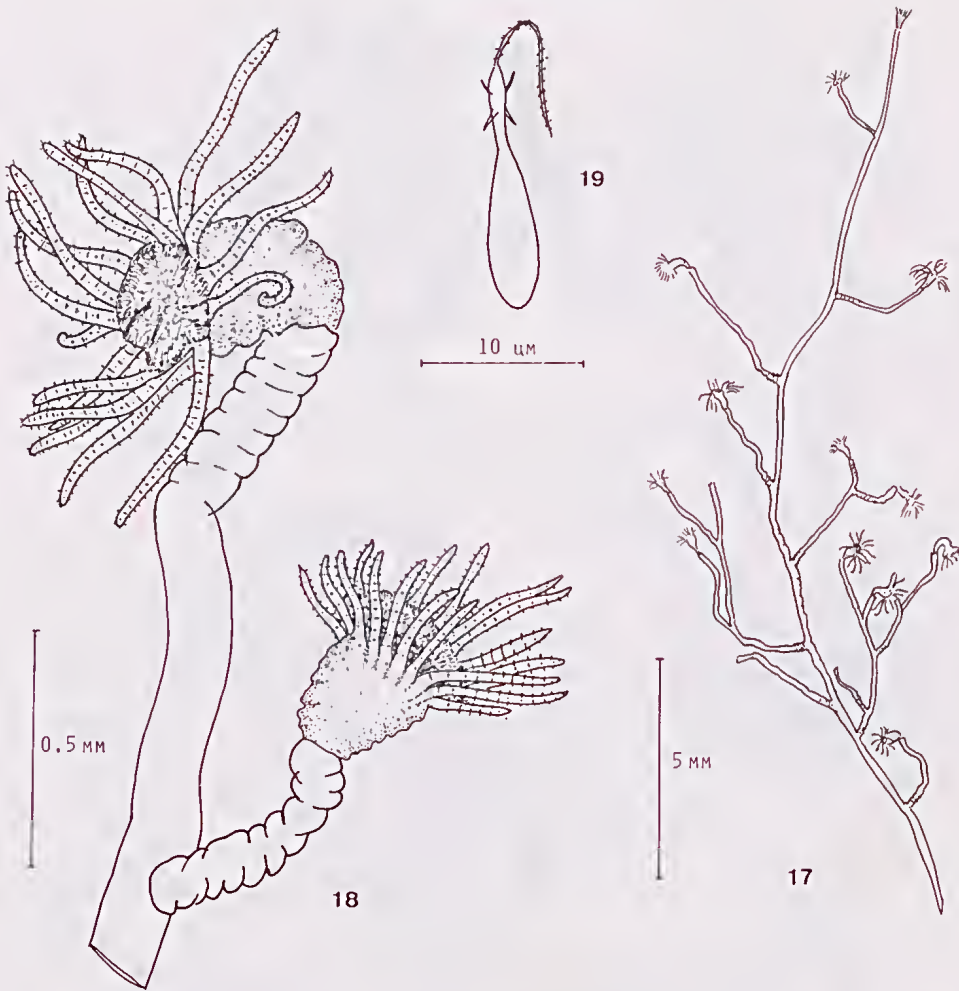
Eudendrium parvum Warren, 1908: 272, Fig. 1, Pl. 45 Figs. 1-4.

Eudendrium ?tenu Agassiz, 1865: 160.

non *Eudendrium capillare* Alder, 1856. Steehow, 1923: 69; 1925: 202. Pennycook, 1959: 168 (in part).

MATERIAL AND RECORD: AMY242. One colony on the brown alga *Hormosira banksii* (Turner) Descainès, Port Jackson, New South Wales, 33° 52' S, 151° 25' E (no other information).

DESCRIPTION: A luxuriant sterile colony heavily investing the algal stipe. Stems up to 25 mm in height, arising from a tangled and intergrown hydrorhiza. Stems unfascicled, irregularly branched, branches bent, seldom straight, often indistinguishable from main stems. Branches with up to 10 annulations at origin, perisarc obscurely wrinkled throughout, especially on hydrothecal pedicels, but occasionally smooth. Hydranths terminal on branches, long and slender (preserved material), with a distinct proximal contraction groove but no nematocyst ring, tentacles long, filiform,



Figs 17-19—*Eudendrium capillare* Alder, 1856. Colony from Port Jackson, N.S.W. 17, Single stem. 18, Distal part of branch with hydranths. 19, Microbasic eurytele from hydranth.

nematocysts prominently displayed, hypostome wide, annular. Nematocysts of one size only, microbasic euryteles, $7-8 \times 2.5-3.5 \mu\text{m}$, shaft $6 \mu\text{m}$, slender, with a few short spines, thread very long and ropy. Moderately abundant on tentacles, absent from hypostome.

MEASUREMENTS, mm: *Branch*, maximum length, 6.7, width at origin, 0.15-0.18, width below hydranth, 0.1-0.13; *Hydranth* (preserved material), width below tentacles, 0.2-0.25, length of body, 0.25-0.45.

REMARKS: As the specimens show characters differing from *E. nambuccense* such as a long, slender hydranth, absence of a nematocyst ring, more annulated branches and pedicels, and number of tentacles, they are here tentatively assigned to *E. capillare*. The main basis of referral is the resemblance to the description of *E. capillare* by Millard (1975). Confirmation of this diagnosis must await the finding of fertile Australian material. The presence of a nematocyst ring on the hydranth would,

however, confirm the species as *E. nambuccense*, not *E. capillare*.

No information is available about the specimen other than the locality, and a note that it was purchased from T. Whitelegge. This indicates that the specimen has probably been in the Australian Museum collection since late last century. Stechow (1923, 1925a) recorded *E. capillare* from Freycinet Reach, Western Australia. Later, Pennycuik (1959) reported the species from Queensland. Examination of Stechow's specimens, loaned by the Naturhistorisches Museum of Vienna, shows that this material is not *E. capillare*; rather, it is identical with a hydroid reported as *E. generale* by Kirkpatrick (1890) from Torres Strait. This hydroid is described elsewhere (p. 194) as a new species. Pennycuik (1959, p. 168) recorded *E. capillare* from Currumbin in southern Queensland and from the Low Isles on the northern Great Barrier Reef. I have examined Pennycuik's

specimens and find that although the meagre Low Isles material is sterile, the abundant undischarged microbasie euryteles suggest that it may be *E. capillare*. Conversely, the presence of heteronemes in the Currumbin specimen clearly demonstrates that this is not *E. capillare*. The latter material is also described in this paper as a new species (p. 209).

Eudendrium terranovac n. sp.

Figs 20-23

?*Eudendrium novaezelandiae* Marktanner-Turneretscher, 1890. Totton, 1930: 141. Farquhar, 1895: 209; 1896: 459. Rösler, 1978; 112, Pl. 20, Fig. 6.

Abundant material of a hydroid found in Bass Strait, Victoria, led to comparison of this material with the specimen taken at North Cape, New Zealand, by the "Terra Nova" expedition and assigned, with considerable doubt by Totton (1930), to *E. novaezelandiae* Marktanner-Turneretscher, 1890. Of *E. novaezelandiae*, Totton remarked that it was "difficult to extract from the original description any diagnostic specific characters". I have examined Totton's specimen and compared it with the type of *E. novaezelandiae*. Examination, especially of the nematocysts, demonstrates conclusively that Totton's specimen is not *E. novaezelandiae*: it is here considered to be a new species, described below. The holotype of *E. novaezelandiae*, and material recently collected in New Zealand, will be described elsewhere (Watson, in prep.).

TYPE MATERIAL AND RECORD: Holotype, one sterile colony, alcohol preserved, BM1929.10.28.11, "Terra Nova" Expedition 1910-1913, Stn 134, North Cape, New Zealand, 34° 18' S, 172° 20' E, depth, 20-37 m, bottom shelly, dredge.

DESCRIPTION OF HOLOTYPE: Colony 50 mm high, dichotomously branched halfway up stem. Stem strongly fasciated to about two-thirds height of colony, branches unfasciated. Branching alternate, branches passing outwards at about 30°, in one plane, with up to 5 proximal annulations, a few superficial annulations at intervals along length, perisarc otherwise smooth and shining. Hydrothecal pedicels rather long, alternate, mostly in one plane at either side of branch, a few directed anteriorly, most curved, but some straight, with 1-4 indefinite proximal annulations, otherwise smooth or indistinctly ringed at intervals. Hydranths well preserved, of moderate size, body long, with a clavate to trumpet-shaped hypostome and 24-28 tentacles, a deep proximal groove around body but no nematocyst ring. Nematocysts abundant, of one kind only: microbasie euryteles, undischarged, capsule pyriform, 6-7 $\mu\text{m} \times 2-3 \mu\text{m}$, in tentacles and on body of hydranth.

MEASUREMENTS, mm: *Stem*, proximal width, 1.24, Distance between alternate branches, 0.9-1.08; *Branch*, length, 2.3-10.8, width at origin, 0.15-0.16; *Hydranth* (preserved material), length of pedicel, 0.7-1.54, width at origin, 0.13-0.18; distance between pedicels, 1.8-2.0, width of body below tentacles, 0.25-0.3.

OTHER MATERIAL: BM1983.8.9.2, one male colony;

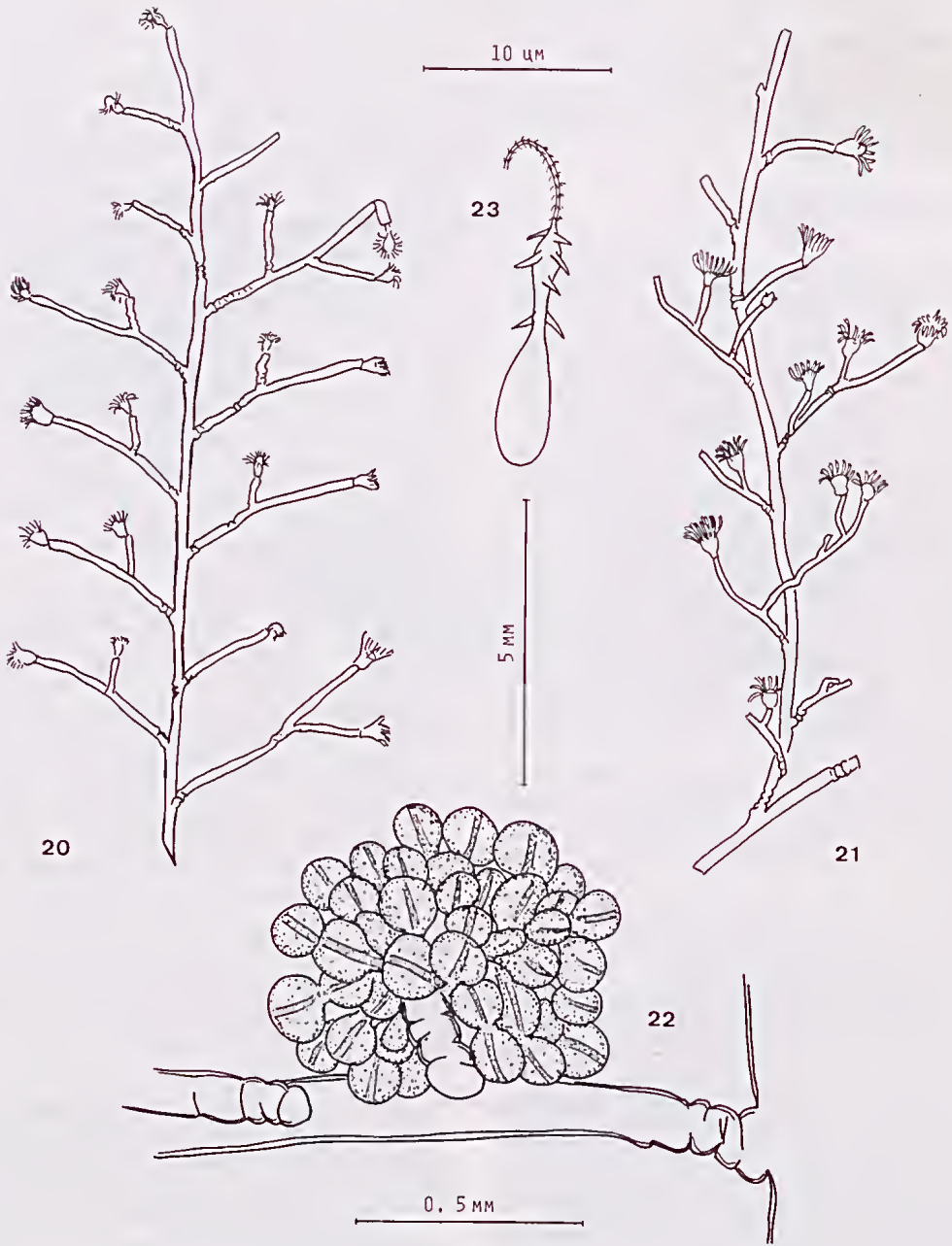
MVF50503, male colony; MVF50504, female colony; all material alcohol preserved; Clifty Island, Bass Strait, 38° 56' S, 146° 43' E, from small caverns and under ledges, depth 10 m; coll: J. E. Watson (SCUBA) 20/5/83. MVF50505, alcohol preserved, Clifty Island, Bass Strait, under ledges, depth 15 m; coll: J. E. Watson (SCUBA) 19/8/82. Additional material also held in collection of author.

SUPPLEMENTARY DESCRIPTION: Colonies up to 6 cm high, the largest comprising 6 stems growing from a common rootstock; other colonies consisting of single stems. Stems erect, straight or sometimes gnarled and bent in proximal region, heavily fasciated for about two-thirds height, fascicular tubes also running along older branches. Branching regularly alternate, mostly in one plane, some rebranching in older, lower parts of stem, branches with up to 9 proximal annulations. Hydranth pedicels alternate on branch, usually in same plane, sometimes anteriorly directed, variable in length, straight or curved, smooth or indistinctly annulated throughout entire length. Body of living hydranth elongate, very extensile with a prominent hypostome and 28-30 long tentacles.

Nematocysts, small microbasie euryteles, capsule 5-6 $\mu\text{m} \times 2 \mu\text{m}$, shaft 5-6 μm , distally inflated, with a few distal spines and a relatively long thread. Moderately abundant in tentacles, a few around hypostome and some scattered on the male gonophores. Gonophores borne on separate colonies, both sexes most numerous on branches in upper third of colony, but absent from distal region of branch. Male gonophores small, 2-chambered, in tightly-packed clusters of about 30 in all phases of development on a blastostyle completely devoid of tentacles at all stages. Distal chamber of immature gonophore peaked, mature gonophore globular. Female gonophores immature, a few borne on a blastostyle showing atrophy of the tentacles from early growth stages, tentacles completely absent at maturity. **MEASUREMENTS, mm:** *Stem*, max. proximal width, 1.85; distance between branches, 1.2-1.4; *Branch*, max. length, 32, width at origin, 0.18-0.25; *Hydranth* (preserved material), length of pedicel, 0.2-1.2, width at origin, 0.13-0.15, distance between pedicels, 0.9-1.34, width of body below tentacles, 0.35-0.45 (living material) max. length of body, 0.3; max. width below tentacles, 0.18-0.43; width across extended tentacles, 2.25; height of hypostome (clavate), 0.15; width across hypostome (annular), 0.38.

COLOUR: Older stems of living material dark brown, grading to lighter brown on younger parts. Body of hydranth variable in colour, from creamy to light brown, hypostome and tentacles white. Mature male gonophores clear, spadix flesh pink.

REMARKS: The Australian specimens are larger and more robust and show a tendency towards less orderly branching than the holotype. The microbasie euryteles are also slightly larger, but the length-width ratio of the capsule is similar (2.5-3:1). *Eudendrium terranovae* is very close to *E. deciduum* Millard, 1957 in size of colony and in possessing only one kind of nematocyst. The abun-



Figs 20-23 — *Eudendrium terranova* n. sp. 20, Branch from holotype, North Cape, New Zealand ("Terra Nova" Expedition). 21, Branch of colony from Clifty Is., Bass Strait, Vic. drawn to same scale. 22, Mature male gonophores from Clifty Is. specimen. 23, Microbasic eurytele from Clifty Is. specimen.

dant Bass Strait material shows that the planar habit of *E. terranovae* is a consistent feature, characteristic of the species, which differentiates it from the more irregularly branched *E. deciduum*. *Eudendrium terranovae* also resembles *E. armatum* Jäderholm, 1909, in colony morphology and possession of only one kind of nematocyst (Bouillon pers. comm.). However, *E. armatum* (known to me only from the literature) has a deeply corrugated hydrothecal pedicel (Jäderholm 1909), a feature not present in *E. terranovae*.

This taxon is the only trans-Tasman species of *Eudendrium* so far recorded. It is a common oceanic hydroid at Clifty Island, offshore from Wilsons Promontory in eastern Bass Strait. It occurs from early to late winter in the sheltered habitat of small caverns at depths of 10-25 m. Several colonies, evidently young ones, which were collected at Clifty Island from a green alga, *Caulerpa flexilis* Lamouroux, were stolonial and unfasciated. At this stage they closely resemble, and are difficult to distinguish from *E. capillare* Alder, 1856.

LABORATORY OBSERVATIONS: Observation on living specimens of *E. terranovae* revealed that the conspicuously-extended clavate hypostome and outstretched tentacles is the normal resting position of the hydranth. When irritated by a probe, the tentacles close and the hypostome instantly retracts to the wide annular or trumpet-shaped hypostome often considered to be a diagnostic feature of *Eudendrium*. Resumption of the resting position occurred within 12-25 sec, measured over 10 hydranths. Four to five consecutive responses could be elicited at increasing time intervals before the hydranth completely failed to respond. This behaviour suggests that, in contrast to species with a more complex cnidome, *E. terranovae* may compensate for its limited nematocyst armament by possession of a very reactive hypostome. In this way, more reliance is placed upon rapid engulfment by the hypostome rather than on entanglement of prey by tentacular threads.

ETYMOLOGY: The species is named after the "Terra Nova", the vessel of the British Antarctic Expedition, 1910.

Eudendrium corrugatum n. sp.

Figs 24-28

TYPE MATERIAL AND RECORD: Holotype MVF50506, one female colony, formalin preserved. Northern Stradbroke Island, 27° 20' S, 153° 35' E, on reef, depth 33 m; coll: R. Willan (SCUBA), 17/6/81.

DESCRIPTION OF HOLOTYPE: Colony comprising three stems 10 cm, 4 cm and 2.5 cm in height, arising from a common rootstock. Main stems strongly fasciated, smooth and shining, the fascicular tubes running from the hydrorhizal filaments to about halfway up the stem and sometimes for a short distance along the branches. Stems alternately branched in one plane in a regular manner, the longest branches in the mid-stem region, upwardly directed (in longest stem) or extending straight out in the smaller stems, occasionally with secondary rebranching. Branches with 8-10 deep annulations at

origin, main stem also ringed at intervals, usually below origin of a branch. Hydrothecal pedicels short, regularly alternate, most given off in plane of branch, short, chiefly straight or sometimes slightly curved, deeply ringed over most or all of their length. Only reproductive hydranths present. Female gonophores borne on lower half of colony, the blastostyle given off as a short secondary pedicel from pedicel of hydranth, 4-6 gonophores present in a cluster below hydranth. Reproductive hydranth without hypostome but with approximately 30 tentacles which may be either atrophied or completely absent. Immature gonophore enclosed in an unbranched spadix, lost at maturity, mature gonophore globular, comprising a single egg enclosed in a thin pellicle; one to five gonophores clustered on blastostyle at late maturity. Nematocysts, small microbasic euryteles of one size only, capsule 8-9 μ m long \times 4 μ m wide, none discharged, a few scattered in tentacles of the blastostyle; a few also on the gonophores.

MEASUREMENTS, mm: *Stem*, proximal width, 1.5, width of fascicular tube of stem, 0.18-0.2; *Branch*, width at origin, 0.23-0.25, maximum length, 40.0, distance between branches, 1.5-3.0; *Hydranth* pedicel, length, 0.5-1.6, width, 0.15-0.2; *Gonophore*, width of mature female, 0.25-0.33.

COLOUR: Main stem deep shining brown, other stems lighter brown.

REMARKS: This large species is characterised by its conspicuously planar form and orderly, alternate branching. Although the only hydranths remaining on the colony are those bearing gonophores, the tentacles of these provide a reasonable estimate of the number on the sterile hydranth. The nematocysts are unusually small and sparse, particularly on the tentacles of the hydranth. *Eudendrium corrugatum* is similar to *E. deciduum* Millard, 1975 from South Africa, and *E. cyathiferum* Jäderholm, 1904 from South Georgia. It differs from the former species in having an unbranched spadix of the female gonophore and differs from the latter species in the more strongly annulated pedicel of the hydrothecal pedicel and blastostyle, as, according to Jäderholm's (1904) figure, the blastostyle of *E. cyathiferum* is not annulated. In some respects, *E. corrugatum* also resembles *E. rameum* Pallas, 1766, in the large size of the colony and in having only one kind of nematocyst (Bouillon pers. comm.). However, since descriptions of *E. rameum* (Allman 1872, Hincks 1868) stress the irregular and profuse branching and strong fasciculation of that species, the Australian specimen is here considered to be a separate species.

ETYMOLOGY: The specific name refers to the neatly corrugated pedicels.

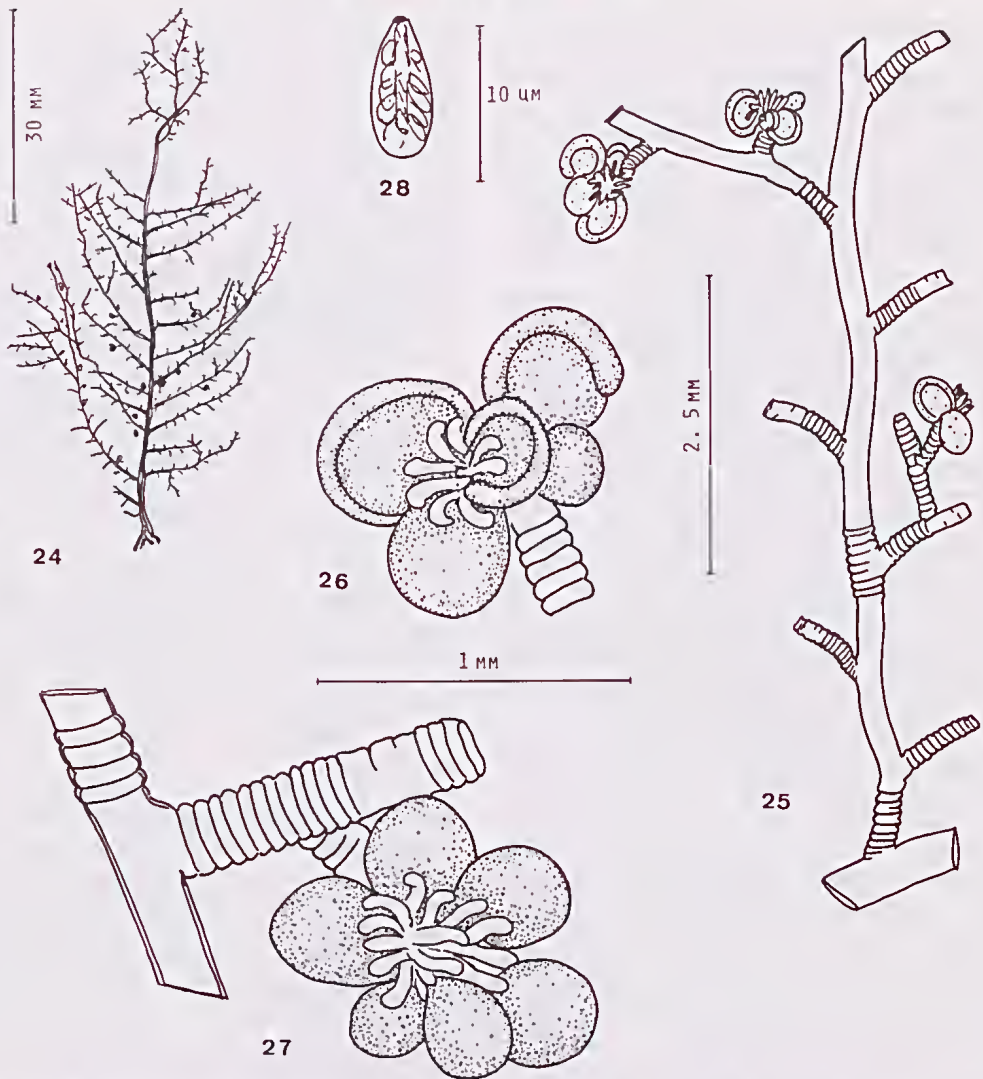
Eudendrium ramosum (Linnaeus, 1758)

Figs 29-34

Corallina tubularia gracilis Ellis, 1755: 31, Pl. 16, Fig. a, Pl. 17, Fig. A,a.

Tubularia ramosa Linnaeus, 1758: 804; 1761: 539.

Tubularia trichoides Pallas, 1766: 84.



Figs 24-28—*Eudendrium corrugatum* n. sp. Drawn from holotype, Stradbroke Is., Qd. 24, Whole colony. 25, Part of branch with female gonophores. 26, 27, Female gonophores. 26, young and mature gonophores. 27, mature gonophores on blastostyle with partly-atrophied tentacles. 28, Microbasic eurytele from hydranth, undischarged.

Tubularia ramosa Linnaeus, 1767: 1302.

Tubularia trichoides Pallas, 1787: 120.

Tubularia ramosa Lamouroux, 1812: 185. Lamarck, 1816: 110.

Tubularia trichoides Lamouroux, 1816: 231.

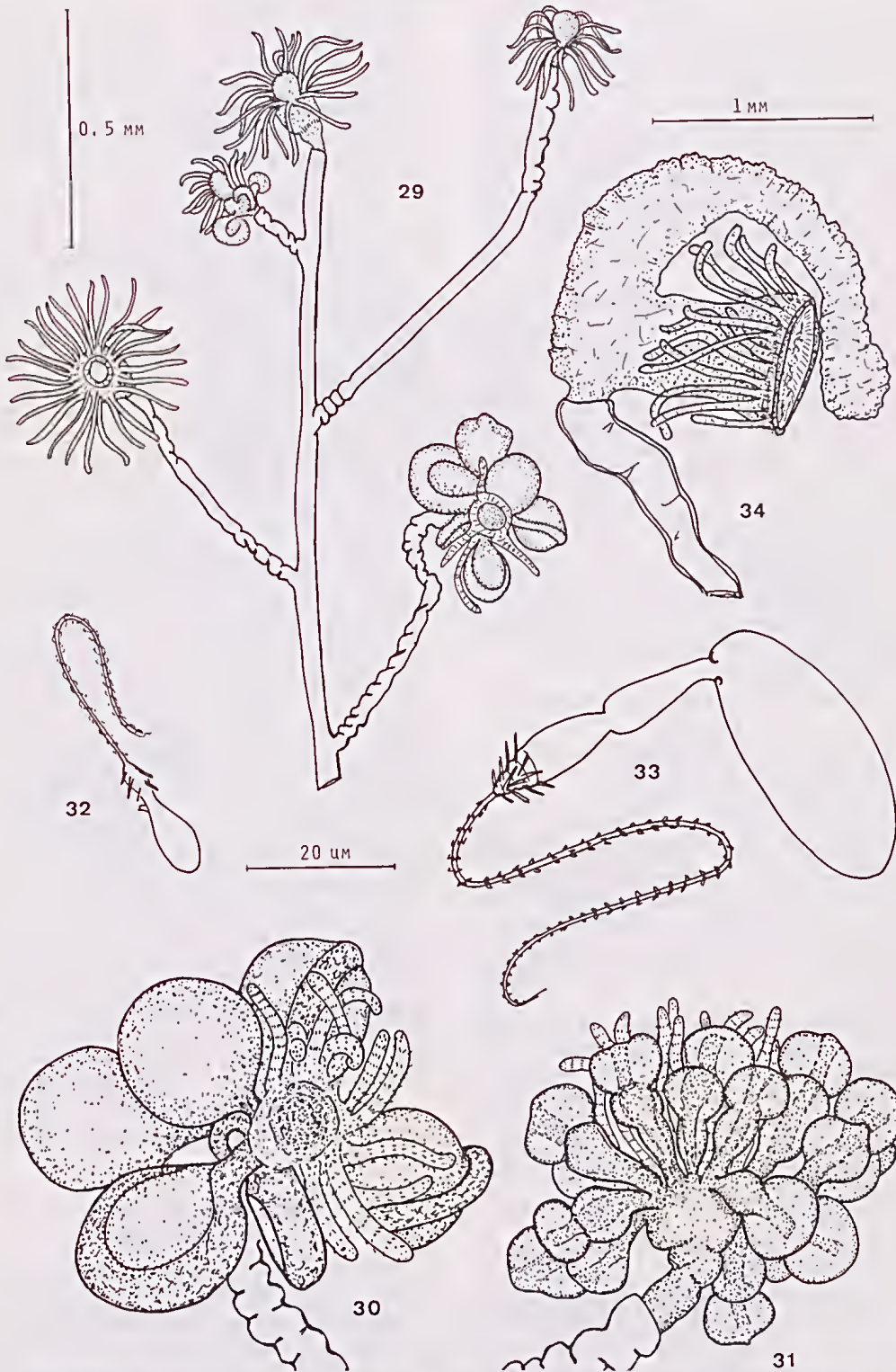
Tubularia ramosa Lamouroux, 1821: 17.

Eudendrium ramosum Ehrenberg, 1834: 296. Thompson, 1844: 283. Gray, 1848: 63. Sars, 1851: 131, 136. Alder, 1858: 103. Wright, 1858: 448. L. Agassiz, 1860-62: 342. Hincks, 1861: 159; 1868: 82, Pl. 13. Allman, 1864a: 362; 1871: 332, Pl. 13, Figs. 1-17. A. Agassiz, 1865: 224. Weismann, 1880: 227. Marktanner-Turneretscher, 1890: 201. Fraser, 1912: 349, Fig. 8; 1944: 72, Pl. 12, Fig. 48. Broch, 1916: 59. Stechow, 1923a: 83. Vervoort, 1946a: 147, Figs. 58, 59. Picard, 1955: 183. Riedl, 1959: 623. Millard,

1966: 456; 1975: 85, Fig. 31. Millard & Bouillon, 1973: 32, Fig. 4; 1974: 19, Fig. 3. Wedler, 1970. Mergner & Wedler, 1977: 12, Pl. 1, Fig. 5. Mergner, 1977: 119-125. Rösler, 1978: 127, Pl. 24, Figs. 1-7.

MATERIAL AND RECORDS: MVF50509, female colony, formalin preserved; coll: J. E. Watson, 20/4/82. MVF50721, male colony, part formalin, part alcohol preserved; coll: J. E. Watson (SCUBA) 20/4/82. All material from side of deep water channel, depth 25 m, Port Phillip Heads, Victoria, 38° 18' S, 144° 40' E. MVF 50511, Bagara reef, Hervey Bay, Queensland, 24° 50' S, 152° 20' E, depth, 6 m; coll: J. E. Watson (SCUBA), 11/11/75.

DESCRIPTION: Colonies up to 20 mm in height. Hydrorhiza tubular, wandering over and through the substrate, becoming erect at intervals as single



Figs 29-34—*Eudendrium ramosum* (Linnacus, 1758). 29, Distal part of stem from colony, Port Phillip Heads, Vic. 30, Immature and mature female gonophores. 31, Mature male gonophores. 32, 33, Nematocysts. 32, Microbasic eurytele from tentacles. 33, Large microbasic eurytele from hypostome. 34, Aberrant hydranth with pseudo-entodipore from colony from Hervey Bay, Qd.

stems. Stems thick and smooth, unfasciated, sparingly and irregularly branched with up to 10 branches, rebranching common. Stems with 6-12 distinct proximal annulations, ringed at intervals throughout length, branches with 6-10 annulations just above origin. Hydranths terminal on branches, pedicels indistinctly annulated at intervals, widening distally, sometimes terminating obliquely below hydranth. Hydranths large, with 24-30 tentacles (very long in life), a distinct proximal groove in the lower body of some, but not all hydranths. Hypostome large, annular to clavate in preserved material.

Sexes on separate colonies, the gonophores scattered on all but the most distal branches. Male gonophores in all stages of maturity borne in a single crowded verticil below a hydranth with a fully-developed hypostome and a full number of partially-atrophied tentacles. Mature gonophore 3 or 4-chambered, immature gonophore with a rod-shaped spadix and a small apical knob without nematocyst pad. Mature gonophore globular or bun-shaped, apical tubercle lost at this stage. Female gonophores borne low on stem, clustered in all stages of development below a hydranth with hypostome and a full number of partially-atrophied tentacles. Young gonophores on a long, thin pedicel, disk-shaped with unbranched spadix, mature gonophores retained below hydranth, oval, containing a single egg encased in a tough gelatinous pellicle.

Nematocysts, microbasic euryteles of two sizes present:

- small microbasic euryteles, capsule $8-9 \times 3-4 \mu\text{m}$, shaft $6-8 \mu\text{m}$ long, with very long thread. Abundant in tentacles (Fig. 32).
- large microbasic euryteles, capsule $38-43 \times 15-18 \mu\text{m}$, bean-shaped, shaft discharging sideways, $30-36 \mu\text{m}$ long, distal end inflated and spirally annulated, with numerous bristles arising from the annulations, thread very long with distinct spines (Fig. 33). Abundant around hypostome and scattered in groups over spadix of immature female gonophore.

MEASUREMENTS, mm: *Hydrorhiza*, stem and branches, width, 0.2-0.25; *Branch*, maximum length, 6.0; *Hydranth* (living material), width below tentacles, 0.4-0.5, max. width across extended tentacles, 2.0; *Hydranth* (preserved material), max. width below tentacles, 0.5; *Pedicel*, width distally, 0.2-0.25, width proximally, 0.13-0.15; *Gonophore*, width of mature female, 0.65-0.75, max. length of mature male series, 0.63, max. width distal chamber, 0.3.

COLOUR: Stems golden brown, body of living hydranth yellow or orange pink, tentacles pale yellow to pink, spadix of female gonophore purplish pink, mature eggs orange, male gonophores pearly pink, spadix orange pink.

REMARKS: None of the material of *E. ramosum* shows any tendency towards the tall, basally-fasciated colonies considered typical of the species by Millard & Bouillon (1973, 1974). The colonies more closely resemble the smaller colonies reported on weed and other hydroids by

Millard (1975). Mergner (pers. comm.) considers that the larger, arborescent colonies of *E. ramosum* are usually found in deeper, calm waters and that smaller colonies, like the present material, are usually associated with stronger water movement. The occurrence of *E. ramosum* in the swift-flowing tide channel at Port Phillip Heads, Victoria, is in accordance with Mergner's view.

The tightly clustered male gonophores of the Australian specimens are in contrast to the sparse whorl of 4-8 gonophores reported by Rösler (1978) in *E. ramosum* from the Mediterranean Sea. Although the supplementary microbasic euryteles of the Australian specimens are 30-50% larger than those reported by Millard (1975) for her South African material, the length-width ratio is similar (Australian, 2.4-2.5:1; South African 2.1-2.5:1). Despite this discrepancy in size, the spirally-armed, sideways-discharging nematocysts are sufficiently distinctive to enable provisional assignment of the Australian material to *E. ramosum*.

About 20% of the hydranths of the Queensland specimens show peculiar outgrowths from the lower body, resembling enidophores. Detailed examination revealed these to be hollow structures connected to the body cavity of the hydranth. Although nematocysts occur on these structures they are aggregated on the proximal, not the distal end as in true cnidophores. Examination of thin sections of these "pseudocnidophores" showed no evidence of parasitic encystment or of foreign larvae. The origin and significance of these structures, occurring only in the tropical material, is therefore unknown.

Eudendrium ramosum is known from Britain, the North Atlantic from the Arctic to the Cape Verdes, the Mediterranean Sea, the Seychelles, South Africa (Millard 1975), the West Indies and the Red Sea (Mergner 1972, 1977). This species is a very common and conspicuous hydroid in the community of the tidal channel at Port Phillip Heads and in other oceanic localities in central Bass Strait where there is good water movement. The distinctively yellow, straggling, but robust colonies occur throughout most of the year, creeping on bryozoans (especially *Sertella granulata* MacGillivray), compound ascidians, sponges and occasionally on red algae. The species is fertile over the winter months.

Eudendrium kirkpatricki n. sp.

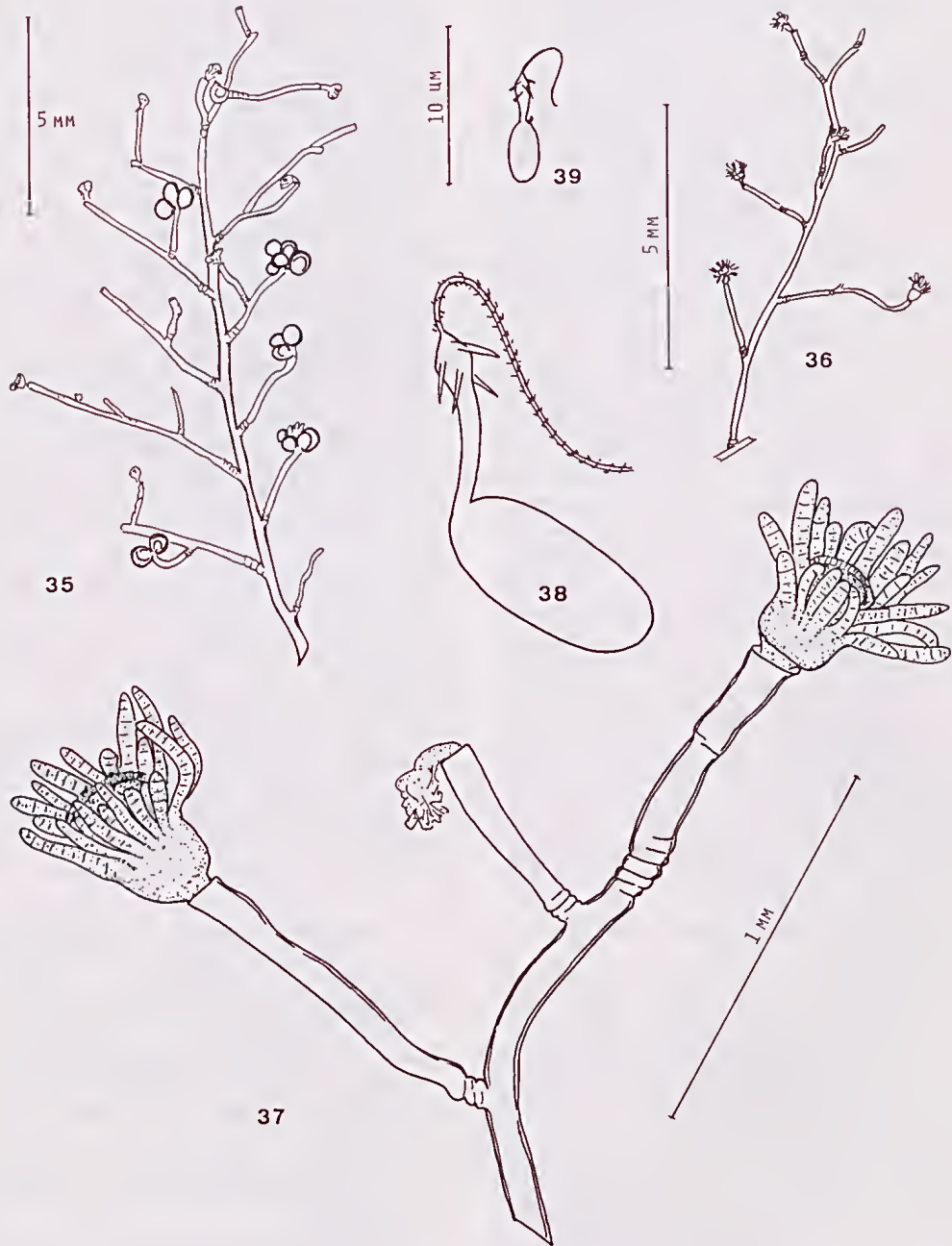
Figs 35-39

Eudendrium generalis von Lendenfeld, 1885.

Kirkpatrick, 1890: 607, Pl. 15, Figs. 1, 2.

Eudendrium capillare Alder, 1856. Stechow, 1925a: 202.

Kirkpatrick (1890) assigned material from Warrior (Tud) Is. and Murray Is. in Torres Strait to *E. generale* von Lendenfeld, 1885. I have examined Kirkpatrick's material and compared it with the type of *E. generale*. Kirkpatrick's specimen is not *E. generale*, but an undescribed species.



Figs 35-39—*Eudendrium kirkpatricki* n. sp. 35, Part of stem, from microslide, BM1890.3.24.113, part of holotype from Torres Strait. 36, 37, Specimen from Port Moresby, Papua New Guinea. 36, Whole stem. 37, Distal part of stem. 38, 39, Nematocysts, drawn to same scale. 38, Microbasal eurytele from hypostome of specimen from Hervey Bay, Qd. 39, Small microbasal eurytele from tentacles of specimen from Papua New Guinea.

TYPE MATERIAL: I select as holotype, BM1890.3.24.113-120, female colony, alcohol preserved (and also microslide preparation, BM1890.3.24.113 from same colony), Murray Is., 9° 55' S, 144° 8' E, depth 27-37 m.

OTHER MATERIAL: BM1890.11.22.35, microslide, part of male colony, Warrior (Tud) Is. 9° 30' S, 142° 54' E, Stn 2; BM1890.11.23.33, male and female stems, alcohol preserved, Warrior Is. MVF50512, Port Moresby, Papua New Guinea, 9° 30' S, 147° 10' E; colony formalin preserved, on worm tube from coral reef, 2-3 m deep; coll: J. E. Watson, June 1981. MVF50513, Hervey Bay, Queensland, 24° 50' S, 152° 20' E; colony formalin preserved, on barnacles from reef, depth, 6 m; coll: J. E. Watson (SCUBA), 14/11/75.

DESCRIPTION: The following description from the holotype and other material supplements that of Kirkpatrick (1890). The Murray Is. (holotype) specimens comprise a colony of about 30 stems up to 20 mm in height, on *Sciurella indivisa* (see Kirkpatrick 1890, p. 608). The Warrior Is. specimens comprise several broken stems, the tallest of which is 43 mm high. Stems unfasciated, main stem straight, perisarc smooth, shining, obscurely annulated at intervals. Branches irregularly alternate, more or less in one plane, upwardly directed, some secondary branching present; branches with a few proximal annulations, widening a little distally. Hydranths small, but too poorly preserved for a tentacle count. Female gonophores borne on all except distal parts of colony, 3-6 in various stages of development tightly clustered around a hydranth, spadix of immature gonophore unbranched. Mature blastostyle devoid of tentacles, the egg-shaped gonophores remaining clustered in their original positions on blastostyle. Male gonophores borne in a verticil below a fully-developed hydranth, 2-chambered and bead-shaped at maturity.

Nematocysts, microbasic caryoteles of two sizes present, few discharged:

- small microbasic caryoteles, capsule $7 \times 3-4 \mu\text{m}$, very abundant in tentacles (Fig. 39).
- larger microbasic caryoteles, capsule bean-shaped, $29-30 \times 13-15 \mu\text{m}$, shaft (seen through wall of capsule), approximately $22 \mu\text{m}$ long, with a very long, coiled thread. Moderately abundant around hypostome (Fig. 38).

MEASUREMENTS, mm: *Stem*, width, 0.18-0.2; *Branch*, maximum length, 0.5-2.75; distance between branches, 0.7-1.8; *Hydranth*, pedicel, proximal width 0.1-0.13, distal width, 0.13-0.18; *Gonophore*, male, length at maturity, 0.23-0.3, width of distal chamber, 0.13-0.15, female, length, 0.28-0.35.

COLOUR: The colonies were probably cream-coloured or yellow in life and the male gonophores deep pink or red.

REMARKS: It is virtually impossible to distinguish between some of the smaller, shrubby species of *Eudendrium* using colony characteristics alone, even when gonophores are present. For example, *E. generale*, *E. capillare* and other small Australian species which are very similar in colony morphology can only be satisfactorily distinguished from each other and from *E. kirkpatricki* by examination of the cnidome. Even if the nematocysts are undischarged, *E. kirkpatricki* can be readily separated from the foregoing species by this means. Although the nematocysts are undischarged in the type material, fully-discharged nematocysts are present in the material from Port Moresby, Papua New Guinea, and from Hervey Bay, Queensland. The smaller, tentacular nematocysts have a rather short, inflated shaft with a few spines. The larger microbasic euryteles always discharge sideways, have a long slender shaft and an small head armed with a few thorn-like spines. The thread bears distinct spirals of bristles.

Through courtesy of the Zoologisches Museum, Hamburg I have been able to examine specimens from Freycinet Reach in Western Australia referred, by Stechow (1923, 1925a), to *E. capillare* Alder, 1856. The cnidome of Stechow's material comprises microbasic euryteles of two distinct sizes, which immediately distinguishes the species from *E. capillare*, a species with microbasic euryteles of only one size or slightly-differing sizes. The longer microbasic caryoteles of Stechow's specimens are slightly smaller, but otherwise identical to those of the holotype of *E. kirkpatricki*. Since nematocysts may show some variation in size over their geographic range, the difference between the cnidome of the two species is not here considered significant. Stechow's material is therefore assigned to *E. kirkpatricki*.

DISTRIBUTION: *Eudendrium kirkpatricki* is one of the most widely distributed of all Australian species of *Eudendrium*, ranging from the southern Great Barrier Reef on the Pacific coast, north to Papua New Guinea and to the western, Indian Ocean, side of the continent. ETYMOLOGY: The species is named after R. Kirkpatrick who first recorded it from Torres Strait.

Eudendrium generale von Lendenfeld, 1885

Figs 40-52

Eudendrium generale von Lendenfeld, 1885: 351, Pl. 6; 1885a: 621; 1887: 16.

Eudendrium generale von Lendenfeld, 1885a: 621. Hartlaub, 1905: 515. Stechow, 1921: 416.

?*Eudendrium generale* von Lendenfeld, 1885. Jarvis, 1922: 333.

non *Eudendrium generale* von Lendenfeld, 1885. Kirkpatrick, 1890: 607, Pl. 15, Figs. 1, 2. Ritchie, 1910: 805.

non *Eudendrium generale* von Lendenfeld. Bale, 1919: 335. Watson, 1982: 89, Fig. 4.6j, Pl. 10.3.

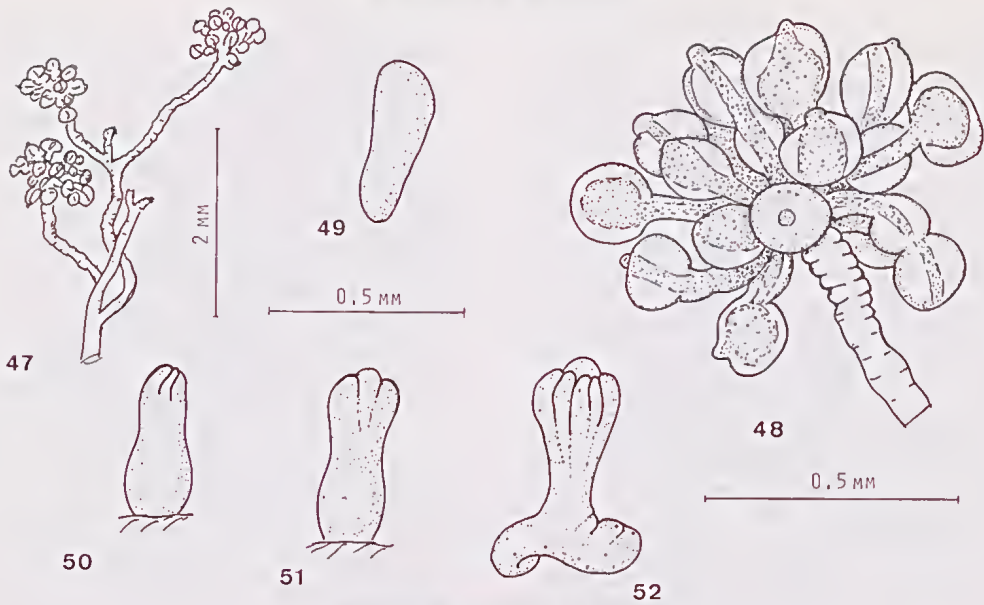
Eudendrium pusilla von Lendenfeld, 1885: 352.

Eudendrium lendenfeldi Briggs, 1922: 150. Rösler, 1978: 104, 120, Pl. 20, Figs. 1-3.

Von Lendenfeld (1885) described two species of *Eudendrium*, *E. generale* and *E. pusilla*, from southeastern Australia but did not designate a holotype specimen for either species from his type series. Part of the type series of each species is held in the Australian Museum and part in the British Museum (Natural



Figs 40-52—*Eudendrium generale* von Lendenfeld, 1885. 40, Part of stem from microslide BM1886.6.8.38. 41-52, Specimens from Western Port, Vic., drawn from living material. 41, Typical stem with female gonophores. 42, Distal part of branch from same stem showing female gonophores in various stages of maturity. 43, Young female blastostyle before complete loss of tentacles. 44-46, Nematocysts, drawn to same scale. 44, Microbasic caryote from tentacles. 45, Large microbasic caryote from hydranth, undischarged. 46, Same, discharged. 47, Part of male colony. 48, Male gonophore cluster. 49-52, Stages in larval development. 49, Newly-released planula. 50, Stage of metamorphosis 12 h after release of planula. 51, Young hydranth 24 h after release. 52, development of hydranth after 48 h.



Figs 47-52—See legend on p. 197.

History). The Australian Museum holdings comprise both microslides and preserved specimens and the British Museum (Natural History) material consists of microslides only. Through courtesy of both museums I have been able to examine and compare the complete type series of both species and it is desirable that a lectotype should now be erected for each. Although von Lendenfeld probably designated his type series from the same colony or from the one collection of material of each species, it is prudent that in erecting lectotypes, only one specimen be nominated from each species.

I therefore designate the following:

Eudendrium generale von Lendenfeld, 1885. Lectotype, AMY203, microslide preparation labelled "*E. generalis* part of type". Lectoparatypes: BM1886.6.8.38, BM1886.6.8.39, microslides labelled "*E. generalis* type"; AMG 9735, spirit-preserved specimen labelled "type" from Port Phillip Bay, Victoria (38° 16' S, 144° 40' E).

Eudendrium pusillum, von Lendenfeld, 1885. Lectotype, microslide labelled "type" AMY204; Lectoparatypes: BM1886.6.8.36a, BM1886.6.8.36c, microslides labelled "*E. pusilla*, type"; AMG 9736, spirit-preserved material labelled "type" from Port Jackson, New South Wales (33° 52' S, 151° 25' E).

The type series of both species is meagre and appears to be the distal fragments of one or several colonies. The condition of the preserved specimens is poor. The stems of specimens in both type series are unfasciated, 0.15 mm in maximum width, and the branches have 3-6 proximal annulations. The male gonophores are 2 or 3-chambered, on a blastostyle devoid of tentacles, distal chamber 0.1-0.5 mm in diameter. Von Lendenfeld noted 24 tentacles on the hydranth of *E. generale* but did not record a number for *E. pusillum*. The lectotype of the latter species also has approximately 24 tentacles. There is no evidence of the ring of "gland cells" (presumably a

nematocyst ring), observed by von Lendenfeld in *E. generale*.

Although all of the extant type material of both species is male, von Lendenfeld described and gave a highly-stylized figure of immature female gonophores of *E. generale*, mistakenly referring to them as the male (see Balch 1919, Kirkpatrick 1890). His figure, therefore, throws little light upon the reproductive structures of *E. generale* other than that the spadix is unbranched and the tentacles are retained on the immature female blastostyle. Although he describes atrophy of the tentacles of the mature blastostyle, the sex of the blastostyle to which he refers cannot be determined from his description. However, from his comments on the colour of the gonophores there is little doubt that he observed living female material, since lost.

A fragment of a hydranth and tentacle of the lectoparatype of *E. pusillum* was examined for nematocysts. Only a few undischarged tentacular microbasic euryteles, capsule $6 \times 3 \mu\text{m}$, were seen. Due to the limited material, no examination could be made of the endome of the lectotype of *E. generale*. Despite the lack of a well-preserved endome, detailed comparison of the full type series of the two species convinces me that there are no significant differences between the two species. Accordingly, I here synonymize *E. pusillum* with *E. generale*.

Identification of a commonly-occurring, southern Australian hydroid as *E. generale* now permits a full redescription of this species.

MATERIAL AND RECORDS: MVF50526, female colony; coll: J. E. Watson (SCUBA), 2/11/71, depth 6 m. MVF50527, female colony, on the brachiopod *Magellania flavescens* Lamarck; coll: J. E. Watson (SCUBA), 6/9/78, depth, 10 m. AMG15224, male colony; coll: J. E. Watson (SCUBA), 10/10/81, depth, 9

m. BM1983.8.9.1, female colony; coll: J. E. Watson (SCUBA), 2/11/71, depth, 9 m. All material formalin preserved, from Crawfish Rock, Western Port, Victoria, 38° 20' S, 145° 15' E. AMG15225, male colony, on worm tube, NE of Flinders Island, Bass Strait, 39° 47' S, 148° 13' E, depth 25 m; coll: CSIRO Fisheries Investigations, scallop dredge, 29/7/38 (M. Blackburn).

DESCRIPTION: The following description is based mainly on abundant material from Western Port, Victoria. Colonies up to 40 mm in height, the tallest erect and shrubby, main stems strongly fascicled, smaller colonies up to 20 mm in height, with unfascicled or very lightly-fascicled stems, arising from a tubular hydrorhiza winding over and through the substrate. Unfascicled stems sparsely branched, fascicled stems complexly branched in many planes. Unfascicled stems with 3-8 proximal annulations grading distally into indistinct corrugations, but sometimes smooth.

Hydranths with 24-30 tentacles in a single verticil around a wide, annular hypostome (preserved material), a contraction groove around lower part of most, but not all, hydranths. Gonophores borne over most of colony, thicker in lower parts, male and female on separate colonies. Male gonophores 2 or 3-chambered, borne in a cluster of up to 20 on a blastostyle from which the tentacles are completely absent at all stages, immature distal chamber often with a terminal knob, lost at maturity. Female gonophores very abundant, most on lower part of colony, initially 4-5 immature gonophores with an unbranched spadix, borne on body of a fully-developed hydranth with hypostome. In later stages, the hydranth may continue to grow ahead of the gonophores, or it may be shed; the blastostyle becomes elongated and corrugated, bearing up to 15 gonophores in various stages of maturity. Mature gonophore oval, on a short pedicel, containing a single egg enclosed in a thick gelatinous pellicle.

Nematocysts, microbasic euryteles of two sizes present:

- large, capsule 5-8 × 3-4 μm, shaft 5-7 μm, very abundant in tentacles, on body of hydranth and on female gonophores (Fig. 44).
- larger microbasic euryteles, capsule bean-shaped, variable in size, 13-15 × 7-9 μm, shaft 12 μm (Western Port material), 21-23 μm, shaft 10-12 μm (Flinders Is. specimens), shaft with a few spines; discharges sideways (Figs 45, 46). Moderately common to rare on body of hydranth and nematocyst ring, when present.

MEASUREMENTS, mm: *Stem* (unfascicled) and branches, diameter, 0.12-0.15; *Hydranth*, max. length of pedicel, 1.75, pedicel, distal width, 0.1-0.15, width below tentacles (preserved material), 0.2-0.3; *Gonophores*, max. width of male cluster, 0.75, length of male series, 0.35-0.4, diameter of distal male chamber, 0.2-0.3, max. width of female cluster, 0.88, diameter of mature female, 0.28-0.3.

COLOUR: Overall colour of reproductive colonies, orange; stems brown, hydranths pink to orange, tentacles paler pink; male gonophores pearly pink, spadix

orange; female gonophores brilliant orange to scarlet.

REMARKS: The colonies of *E. generale* from the Bass Strait region (including Western Port and Flinders Is.) are short and usually unfascicled at early maturity. Heavily-fascicled colonies from Western Port are probably quite old, and it is suspected that the hydrorhizal filaments and main stems of these colonies may exist over several seasons (pers. obs.). While the Flinders Is. specimens are similar in colony morphology with the younger unfascicled, or lightly-fascicled colonies on brachiopod shells from Western Port, the supplementary microbasic euryteles of the Flinders Is. specimens are much larger than those from Western Port. However, the length-width ratio remains the same throughout the material examined, ranging from 1.7-1.9:1.

Examination of the cnidome was carried out on abundant living material of *E. generale*. In mature colonies, the large supplementary microbasic euryteles were present in the nematocyst ring ("gland cells" of von Lendenfeld) around the body of young, unreproductive hydranths on the distal branches. They occurred on only 25% of these hydranths and were never associated with the hypostome. As the hydranth becomes fertile the supplementary nematocysts move outwards in scattered groups on the surface of the developing gonophore. They are, however, never aggregated into nematocyst pads. When lost, the nematocysts are not replaced, so that by maturity, none remain on the gonophore. These observations are not in agreement with Mergner (see Rösler, 1978 p. 86) who considers that nematocyst pads on the female gonophore are characteristic of *E. generale*. Problems in separation of *E. generale* from *E. capillare* have been pointed out by Vervoort (1941) and by Nutting (1896) in discussion of *E. album*. Rösler (1978) also admits difficulty in distinguishing *E. generale* from *E. speciosum* Fraser, 1945. The problem of distinguishing morphologically-similar species from *E. generale* is compounded by the fugitive behaviour, and variations in relative abundance, of the supplementary nematocysts of *E. generale*. Failure to detect the larger microbasic euryteles would then lead to confusion of small colonies of *E. generale* with *E. capillare*, even if the material were fertile.

Pennycuik (1959) was uncertain whether her small sterile colonies from Currumbin, Queensland, were *E. generale* or *E. capillare*. Examination of her specimens, loaned by the Queensland Museum, revealed the presence of abundant heteronemes, demonstrating that her material is neither of these species. This material is described elsewhere in this paper (p. 209). Bale (1884) briefly described, but was unable to clearly identify a small specimen of *Eudendrium* from Portland, Victoria. His comments, and observations by the present author, suggest that his specimen was probably *E. generale*. I have also examined a series of microslides labelled 1959.33.129-135, Station 22, Mergui Archipelago, identified by Ritchie (1910) as *E. generalis* von Lendenfeld, kindly loaned by the Royal Scottish Museum, Edinburgh. Although the material is rather impoverished and difficult to diagnose in the thick Canada Balsam moun-

tant, some undischarged nematocysts are reasonably clear. The tentacular microbasic euryteles measure $10\text{--}11 \times 4\text{--}5 \mu\text{m}$, and the supplementary microbasic euryteles measure $25\text{--}28 \times 10\text{--}13 \mu\text{m}$. Although the kind of cnidome agrees with that of *E. generale*, both the tentacular and supplementary microbasic euryteles are larger, having a capsular length-width ratio of 2.4:1 for both sizes of nematocysts. This ratio is greater than those in *E. generale* from Australia (1.8:1, tentacular, and 2:1, supplementary nematocysts). Further, the partially-reduced tentacles of the mature female blastostyle show that the Mergui specimens cannot be *E. generale*; they may, however, be *E. capillare* as described by Millard (1975) and by Vannucci (1954). Until the male gonophore of the Mergui species is found, the identity of Ritchie's species remains uncertain.

Hargitt (1927), in referring a specimen from Amoy in the South China Sea to *E. pusillum* var. *amoyicum*, considered that the differences exhibited by the varietal form might eventually warrant its separation as a new species. I have examined a microslide labelled "type of *E. pusillum* var. *amoyicum*" kindly loaned by the Smithsonian Institution (USNM 42637). The specimen is a mature unfasciated and branched female stem. It is very similar to *E. generale* although distinctly smaller in size. It is not well preserved, but the cnidome is sufficiently clear to show abundant small tentacular microbasic euryteles and a few larger microbasic euryteles, none of which are discharged. Capsular dimensions of the latter nematocysts are, length, $20 \mu\text{m}$, and width, $10 \mu\text{m}$. Ling (1938) described a male colony of the var. *amoyicum* from the Chushan Islands. The gonophores are borne on a blastostyle without tentacles. This evidence confirms the close relationship of var. *amoyicum* with *E. generale*. However, the much smaller size of the colonies suggests that further study should be made of fresh material before a decision is made as to its systematic status. For the present, the South China Sea material is regarded as probably a distinct species.

REPRODUCTION: Colonies from Western Port, Victoria, released planulae in the laboratory aquarium. The elongate planulae descend on mucous strings and crawl slowly away from the parent colony in the manner described in *E. rameum* by Wasserthal and Wasserthal (1975). Over a period of 12 h the planulae metamorphosed to a dumb-bell shape, aboral pole down, the upward-facing oral pole showing a trace of differentiation of tentacles. Between 24–48 h, a young hydranth 0.5 mm in height with hypostome surrounded by embryonic tentacles began to develop. At this stage the aboral pole extended each side of the peduncle as a rudimentary hydrorhiza. Observations were terminated after 48 h.

Although young colonies of *E. generale* are small and relatively inconspicuous, the brilliant orange to scarlet colour of mature colonies, remarked upon by von Lendenfeld, is unmistakable in the field. Under favourable conditions *E. generale* forms dense meadows on sponges and ascidians, often sharing its habitat with another hydroid described as a new species later in this paper (p. 205). Young, lightly-fasciated colonies occur

on pebbles and on old shells in shallow water while the more luxuriant older colonies are usually confined to deeper waters. *Eudendrium generale* is fertile from late spring (September) to autumn (April).

DISTRIBUTION: From Portland, Victoria (pers. obs.) to temperate New South Wales.

Eudendrium merulum n. sp.

Figs 53–58

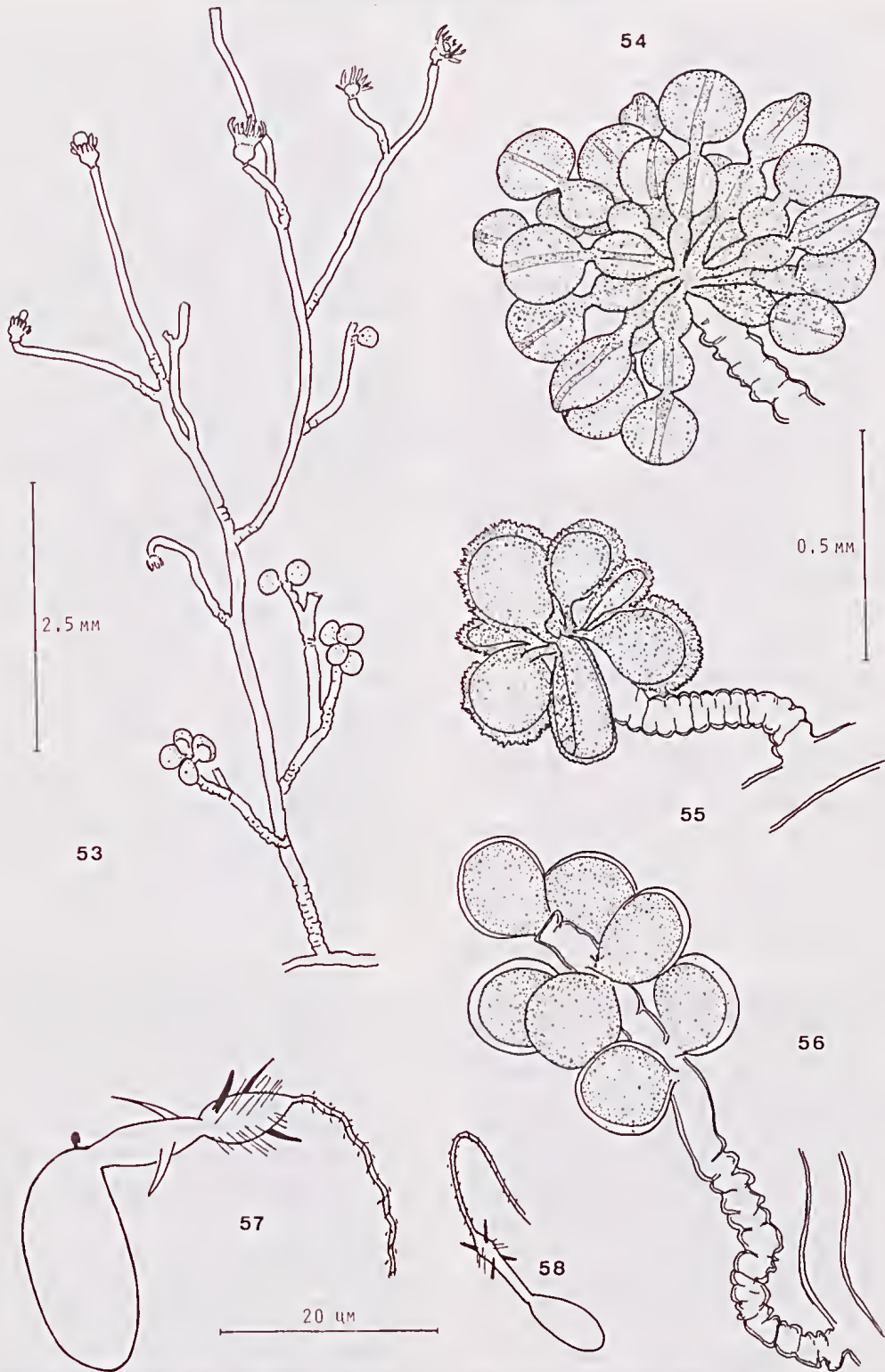
TYPE MATERIAL AND RECORD: Holotype, MVF50514, female colony. Paratypes, MVF50515, female colony; MVF50516, female colony; MVF50517, male colony. All material alcohol preserved, 0.5 km south of Clonmel Island, Bass Strait, Victoria, $38^\circ 45' \text{S}$, $146^\circ 43' \text{E}$, from wreck of steamer "Blackbird", depth, 6 m; coll: J. E. Watson (SCUBA), 16/3/83. Other material: MVF50518, male colony, formalin preserved, coral reef, 2 m deep, Palm Isles, Queensland, $18^\circ 40' \text{S}$, $146^\circ 30' \text{E}$; coll: J. E. Watson (SCUBA), 28/6/73.

DESCRIPTION FROM HOLOTYPE AND PARATYPES: Hydro-rhiza tubular, giving rise to simple or branched stems of the same diameter. Stems erect, up to 20 mm in height, unfasciated, lower stems roughly annulated up to the lowest branch, branching and rebranching sparse and irregular, in all planes, branches straight or undulated, upwardly directed, with up to 12 indistinct proximal annulations. Perisarc of lower stems thick and shining, becoming markedly thinner in distal region.

Hydranths small, with approximately 24 tentacles surrounding a club-shaped hypostome (preserved material) and a distinct contraction groove around the base below a nematocyst ring containing a few large nematocysts. Sexes borne on separate colonies. Female gonophores borne thickly, on lower parts of colony, clusters extending to halfway up stems, immature gonophores disk-shaped with a curved, unbranched spadix, in a verticil surrounding a hydranth without hypostome. Mature female gonophore globular, containing one egg enclosed in a thin pellicle, up to 6 gonophores scattered along a wrinkled blastostyle devoid of tentacles. Male gonophores borne on lower stems, in a dense cluster of up to 20 on a wrinkled blastostyle completely devoid of tentacles at all stages. Gonophores 2 or 3-chambered, the chambers connected by a distinct neck; immature gonophores elongate, some with an apical knob, mature gonophores bead-shaped.

Nematocysts, microbasic euryteles of two sizes present:

- large microbasic euryteles, capsule bean-shaped, $19\text{--}23 \times 9\text{--}12 \mu\text{m}$, shaft discharging sideways, about $20 \mu\text{m}$ long, rather delicate and easily collapsed, armed with numerous spines and bristles, thread rosy (Fig. 57). Present around hypostome, in the nematocyst ring on the hydranth and grouped circumferentially on spadix of female gonophore.
- small microbasic euryteles, capsule $7\text{--}9 \times 3 \mu\text{m}$, shaft $7\text{--}9 \mu\text{m}$, long and thin with at least two sets of spines on head, the distal spines facing forward. Abundant on tentacles (Fig. 58).



Figs 53-58—*Eudendrium merulum* n. sp. 53, Whole stem from holotype, Bass Strait, Vic. 54, Mature male gonophores from paratype colony. 55, 56, Female gonophores from holotype. 55, Immature gonophores. 56, Mature gonophores. 57, 58, Nematocysts, drawn to same scale. 57, Large microbasic eurytele from hypostome, discharged. 58, Small microbasic eurytele from tentacles.

MEASUREMENTS, mm: *Stem* and *branches*, width, 0.08-0.11; *Pediceal*, distal width, 0.08-0.1; *Hydranth*, (preserved material) width below tentacles 0.13-0.18; *Gonophores*, female, diameter of cluster, 0.6-0.7, max. mature diameter, 0.28, male, max. diameter of distal chamber, 0.2.

COLOUR: Lower stems dark brown, becoming almost colourless distally below hydranth. Hydranths flesh coloured to orange, female gonophores orange, spadix of immature gonophore white to purplish; male gonophore pearly or clear, spadix yellow, brown or orange.

REMARKS: Colonies of *E. merulum* are indistinguishable in the field from *E. generale* von Lendenfeld, 1885. In microscopic characters the species is, however, easily differentiated from *E. generale* by the larger size of the microbasic euryteles and the complete absence of tentacles from the mature male and female blastostyles. The tentacular nematocysts proved to be very difficult to discharge, even in living material.

Eudendrium merulum is a small hydroid which prefers a shaded microhabitat in good current flow, and particularly favours situations where edge effects (Foster 1975) are dominant. Under these conditions it forms extensive hydroid meadows.

OTHER MATERIAL: The Queensland material is limited, comprising one small colony which shows some variation from the type series in size of nematocysts and atrophy of the tentacles of the male blastostyle. For this reason it is described separately. The colonies are shorter than those of the type material, being up to 10 mm in height. While other colony characters are similar, the stem and branches are thicker (0.13-0.2 mm), there are fewer proximal annulations (2-4) on the branches, and occasionally there are groups of corrugations about midway along the branches. The immature male gonophores are 2-chambered, borne on a blastostyle with fully-developed tentacles. This condition contrasts with the type specimen where the tentacles of the male blastostyle are completely absent at all stages of development.

The tentacular microbasic euryteles are similar in size to those of the type, the capsule being $7.8 \times 3.4 \mu\text{m}$ and the shaft $7.9 \mu\text{m}$ long, with a very thick thread. The hypostomal nematocysts are slightly longer than those of the type, the capsule being $22.23 \mu\text{m} \times 10.11 \mu\text{m}$, shaft $16.20 \mu\text{m}$ long, also with a thick, ropy thread. The length-width ratio is, however, similar, the ratio of the type being 1.9-2.1:1, while that of the Queensland specimens is 2.1-2.2:1. Until further tropical material is available for study, the Queensland specimen is provisionally assigned to *E. merulum*.

ETYMOLOGY: The species is named after the wreck of the steamer "Blackbird", off Port Albert, Victoria.

Eudendrium carneum Clarke, 1882

Figs 59-62

Eudendrium carneum, Clarke, 1882: 137, Pl. 7, Figs 10-17. Vannucci, 1954: 101, Pl. 1. Figs 1-9, Pl. 2,

Fig. 8, Pl. 4, Figs. 2-5. Millard, 1959: 302, Fig. 1A-F.

Vervoort, 1968: 8. Rösler, 1978: 55, Pl. 9, Figs 1-6. MATERIAL AND RECORDS: WAM95-1957, two female colonies, alcohol preserved, South Mole, Fremantle, Western Australia, $31^{\circ} 55' \text{S}$, $115^{\circ} 45' \text{E}$, from wharf pile (no depth); coll: B. R. Wilson, March, 1957. MVF50724, two female colonies, alcohol preserved, North Mole, Fremantle, Western Australia, depth 6m; coll: J. E. Watson, 25/11/83.

DESCRIPTION: All specimens are large arborescent colonies reaching a height of 18 cm. The colonies from South Mole are richly branched and bear very young female gonophores. Those from North Mole are senescent and overgrown by algae and other hydroids. One colony bears female gonophores in various stages of development. Mains stems thick, gnarled and heavily fascicled, the fasciculations extending to all but the growing tips of the colony and along the primary branches. Branching profuse, irregular, each branch with 4-7 deep proximal annulations, the younger branches sometimes with scattered groups of annulations, perisare otherwise smooth, thick and shining.

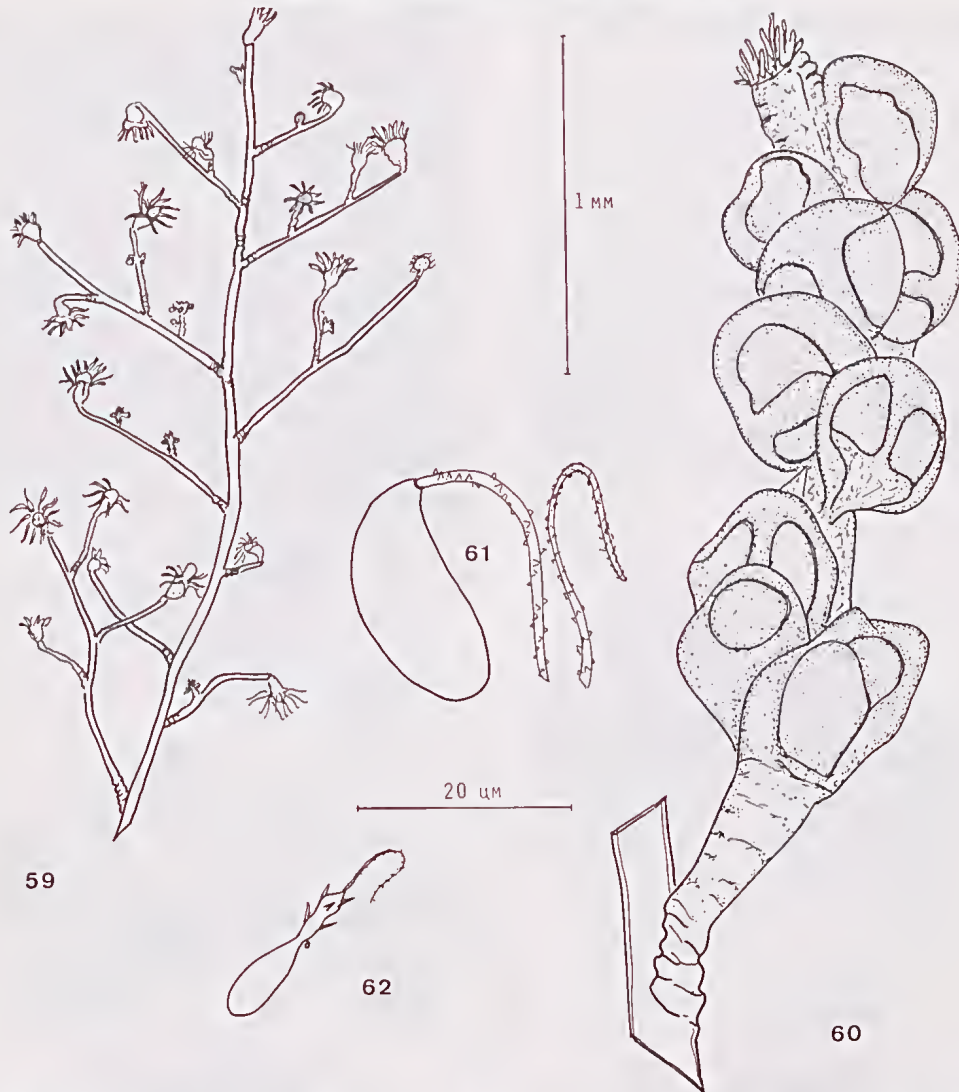
Hydranths large, of elegant form, with a long body and 28-32 tentacles, a very prominent clavate hypostome (preserved material), and a distinct contraction groove at base. Female gonophores borne on a specialised blastostyle on a short wrinkled pedicel arising from the smaller branches. Immature gonophores small, knob-like, 4-6 borne in a whorl below a hydranth with 10-14 atrophied tentacles; gonophores later developing a bifurcated spadix. Mature gonophores in elongate clusters of 5-8 scattered along a thickened blastostyle which may be surmounted by a cluster of remnant tentacles without hypostome, each gonophore enclosed in a capsule of perisare with two large fenestrations.

Nematocysts of two kinds present:

- large heterotrichous anisorhizas, capsule loaf-shaped, $20.22 \times 9.11 \mu\text{m}$, thread very long (up to 1 mm), $1.3 \mu\text{m}$ wide proximally, armed with thorn-like spines, tapering distally to $0.5 \mu\text{m}$ diameter, the spines becoming smaller and more closely spaced distally (Fig. 61). Very abundant on body of hydranth, in nematocyst ring, on spadix of immature gonophore and scattered on body of the mature gonophore.
- microbasic euryteles, capsule pyriform, $8.9 \times 3 \mu\text{m}$, shaft $6 \times 2 \mu\text{m}$ with several long spines, thread moderately long with small bristle-like spines (Fig. 62). Moderately abundant in tentacles.

MEASUREMENTS, mm: *Main stem*, max. width, 7-8; *Main branches*, max. width, 0.25; *Distal branches*, proximal width, 0.1-0.18; *Hydranth* (preserved material), length of body, 0.3-0.4, width below tentacles, 0.3-0.4; *Mature gonophore*, length, 0.35-0.4; width, 0.3-0.35.

REMARKS: The colonies correspond exactly to the description of *Eudendrium carneum* given by Millard (1959) for specimens from the east coast of South Africa. The large, strongly-fascicled colonies, the bifurcated female spadix and the fenestrate capsule of the



Figs 59-62—*Eudendrium carneum* Clarke, 1882. 59, Distal part of branch from female colony from Fremantle, W.A. 60, Female blastostyle with mature gonophores surmounted by a reduced hydranth. 61, 62, Nematocysts, drawn to same scale. 61, Large heterotrichous anisorhiza from hydranth. 62, Microbasic euryte from tentacles.

mature female gonophore readily distinguish this species from all others. Examination of the cnidome of freshly-collected material shows the larger nematocysts to be heterotrichous anisorhizas, not atrichous isorhizas as reported by Millard (1959). When undischarged, the relatively short distal end of the thread is obscured by the loose proximal coils in the capsule, and is thus easily overlooked. Most of the colonies appear to be quite old, many of the branches showing evidence of breakage, most likely due to fish grazing, followed by regeneration. Each regeneration commences with a few deep annulations. Many of the fascicular tubes on the stem and branches show a downwardly growing tip, suggesting that the strongly-fascieled habit of the colonies may be a result of gregarious larval settlement on the colony rather than upward growth from the parent rootstock.

The colonies from Western Australia are pale orange in life, not brilliant vermilion as reported for American specimens by Clarke (1882).

Eudendrium carneum is known from the Atlantic and Pacific coasts of North America, the north-eastern coast of South America, St. Helena, southern Africa and the tropical east Pacific. The Australian record of *E. carneum* is from wharf pilings and on rocks at the entrance to the Port of Fremantle, where it has been established for at least 26 years. This is a similar habitat, associated with shipping, to that recorded from Durban in east Africa by Millard (1959). Other records probably associated with shipping are the Suez Canal, the Hampstead Roads, Virginia, U.S.A. (Clarke 1882) and Santa Marta, Colombia (Wedler 1975).

This is a new record for Australia and the east Indian Ocean.

Eudendrium racemosum (Cavolini, 1785)

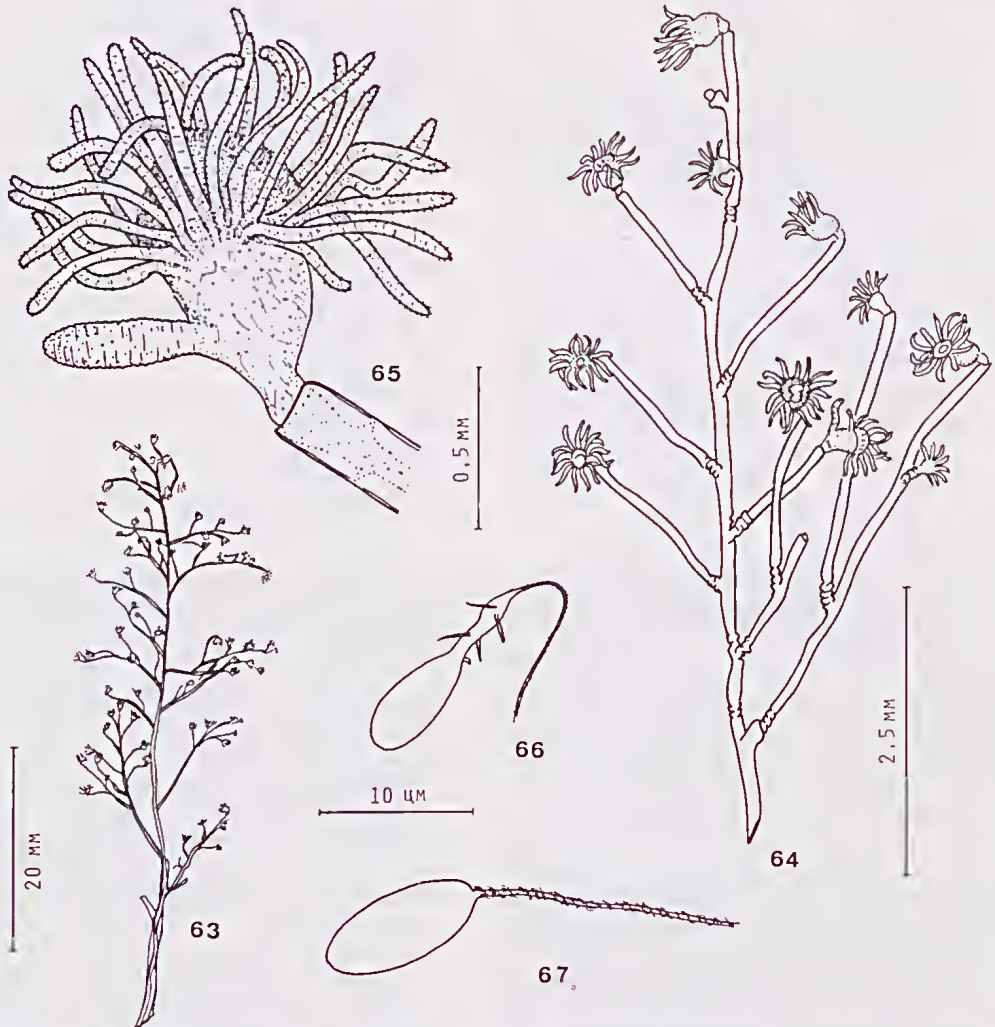
Figs 63-67

Sertolara racemosa Cavolini, 1785: 160, Pl. 6, Figs. 1-7, 14, 15.*Sertularia racemosa* Gmelin, 1788-93: 3854. Sprengel, 1813: 73, Pl. 6.

Eudendrium racemosum Ehrenberg, 1834: 296. Alder, 1856: 356. Allman, 1864a: 387, 407; 1871: 148, 341. Weismann, 1881: 1, Pl. 1, Figs. 1-8. Von Lendenfeld, 1885: 351, 353. Schneider, 1879: 477. Hargitt, 1900: 240; 1904: 259, Pl. 14, Fig. 1. Billard, 1904: 103. Hartlaub, 1905: 551. Motz-Kossowska, 1905: 53. Stechow, 1920: 32; 1923a, 83; 1923b: 4. Picard, 1955: 183. Mergner, 1957: 63, Figs. 1-96, Pl. 1. Riedl, 1959: 621. Hanisch, 1970: 1, Figs. 1-45. Millard & Bouillon, 1973: 33. Rösler, 1978: 123, Pl. 22, Figs. 1-4.

MATERIAL AND RECORDS: MVF50519, one sterile colony, formalin preserved, from reef, 25 m deep, Stradbroke Is., Queensland, 27° 20' S, 153° 35' E; coll: J. E. Watson (SCUBA), 24/8/75. MVF51783, female colonies, alcohol preserved, coral reef, 6 m deep, Raine Is., Queensland, 11° 36' S, 144° 1' E; coll: A. L. Ayling (SCUBA), 9/4/84.

DESCRIPTION: Colonies of moderate height, ranging from 30-70 mm, main stems unfasciated or with one supplementary fascicular tube. The colony from Stradbroke Is. is irregularly branched in several planes around stem; those from Raine Is. show a tendency towards a more planar habit. Primary branches long, particularly those in the proximal stem region, secondary branches bearing hydranth pedicels. Branches with a few spiral annulations at origin; groups of annulations sometimes at irregular intervals along branch, perisarc otherwise smooth. Hydranths large, with an open trumpet-shaped



Figs 63-67—*Eudendrium racemosum* (Cavolini, 1785). Colony from Stradbroke Island, Qd. 63, Whole stem. 64, Distal end of branch. 65, Hydranth with cnidophore. 66, 67, Nematocysts, drawn to same scale. 66, Microbasic eurytele, undischarged, from tentacles. 67, Atrichous isorhiza, discharged, from cnidophore.

and sometimes fluted hypostome (preserved material), surrounded by 27-30 tentacles, a contraction groove and an indistinct nematocyst ring in the proximal region. A enidophore (Weismann 1881) present in 20% of hydranths, arising just above the contraction groove, usually on hydranths in the proximal region of the branch. The enidophore is usually thicker than the tentacles and often several times the length of the hydranth, the distal end thickly armed with nematocysts. Female gonophores borne in clusters of up to 10 on a wrinkled blastostyle below a hydranth with a reduced number of partially-atrophied tentacles. Spadix of female bifurcated in early stages of development, the bifurcation remaining until the egg reaches maturity.

Nematocysts of two kinds present, none discharged:

- small microbasic euryteles, capsule $6.5-7 \times 2-3 \mu\text{m}$, shaft $5-6 \mu\text{m}$, very abundant in tentacles (Fig. 66).
- atrichous isorhizas, capsule bean-shaped, $9-11 \times 3.5-4 \mu\text{m}$ wide, thread moderately long, finely spinous, loosely coiled inside capsule when undischarged (Fig. 67). Moderately common around hypostome and very abundant on enidophore.

MEASUREMENTS, mm: *Stem*, max. width, 0.75; *Branch*, max. length, 25, width of branch and pedicel, 0.15-0.23; *Hydranth* (preserved material), width below tentacles, 0.25-0.6.

REMARKS: *Eudendrium racemosum* is known from the Mediterranean Sea (Mergner 1957), the Seychelles (Millard & Bouillon 1973), Vietnam (Leloup 1937) and Japan (Stechow 1913, Yamada 1959, Hirohito 1969). This is the first record from the South Pacific region. The species is probably widely distributed throughout the Australian tropics, the two present records being from the northern and the southern extremes of the Great Barrier Reef.

Eudendrium balei n. sp.

Figs 68-74

non Eudendrium generale von Lendenfeld, 1885. Bale, 1919: 335. Watson, 1982: 89, Fig. 4.6j, Pl. 10.3.

TYPE MATERIAL AND RECORDS: Holotype, MVF50521, female colony, formalin preserved, Crawfish Rock, Western Port, Victoria, $38^{\circ} 20' \text{S}$, $145^{\circ} 15' \text{E}$, depth, 10 m; coll: J. E. Watson (SCUBA), 2/11/71. Paratypes: MVF50522, female colony, formalin preserved, Crawfish Rock, Western Port, depth, 10 m; coll: J. E. Watson (SCUBA), 13/9/68. MVF50530, male colony, formalin preserved. Crawfish Rock; coll: J. E. Watson, 10/10/81. MVF50523, male colony, from reef 15 m deep, Seaspray, Victoria, $38^{\circ} 30' \text{S}$, $147^{\circ} 10' \text{E}$; coll: J. E. Watson (SCUBA), 27/10/81. MVF50720, sterile stem, Stn 20, Museum of Victoria Survey, Bass Strait, Victoria, $37^{\circ} 59' \text{S}$, $148^{\circ} 27' \text{E}$, depth 51 m; trawl, 1/7/83. Bottom, muddy sand, fine shell.

OTHER MATERIAL: MVF50525, Gabo Is., Victoria $37^{\circ} 35' \text{S}$, $149^{\circ} 55' \text{E}$, depth, 6m; coll: J. E. Watson (SCUBA), 15/2/73. MVF50524, from experimental

fouling panels, Sydney Harbour, New South Wales, $33^{\circ} 50' \text{S}$, $151^{\circ} 15' \text{E}$; coll: G. Russ, January 1974.

DESCRIPTION FROM HOLOTYPE AND PARATYPES: Colonies up to 10 cm in height. Hydorrhiza a tangled mass of tubes, becoming erect at intervals as stems. Stems more or less straight, perisarc thick, smooth, shining, fascicled to about halfway up colony, primary branches long, of same diameter as stem, given off irregularly or in an irregular whorl in three planes at an acute angle to stem. Rebranching common, repeated up to 5 times, each branch commencing with up to 7 distinct annulations, minor branches and hydranth pedicels often indistinctly corrugated throughout their length. Hydranth pedicels long, perisarc usually terminating sharply well below hydranth, but sometimes grading into hydranth. Hydranths large, with 20-24 tentacles surrounded by a wide hypostome; usually a contraction groove near base. Sexes on separate colonies, male and female gonophores borne on all parts of colony except the most distal branches. Male gonophore 3-chambered, in clusters of up to 12 on a wrinkled pedicel below a fully-formed hydranth, immature gonophore with a tiny apical tubercle, lost at maturity, distal chamber of mature gonophore bun-shaped with inflated spadix. Female gonophores borne below a fully-developed hydranth with a hypostome and a reduced number of tentacles (see remarks), up to 20 gonophores in various stages of maturity scattered along a wrinkled blastostyle. Immature gonophores large, spadix unbranched, with scattered clusters of nematocysts. Mature gonophore egg-shaped, on a short pedicel, containing a single egg enclosed in a very thin transparent pellicle.

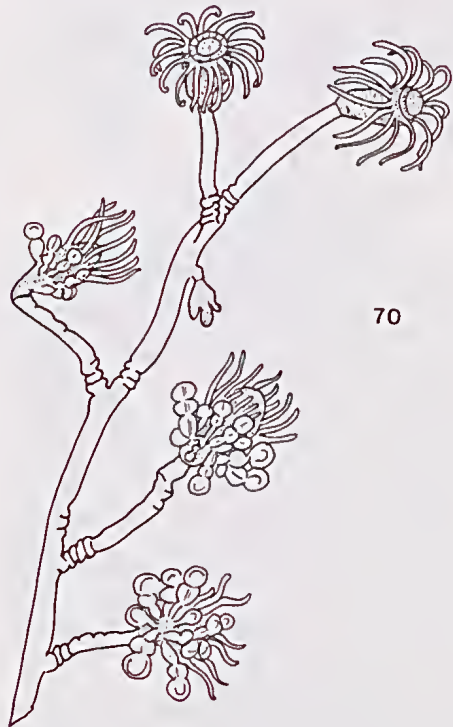
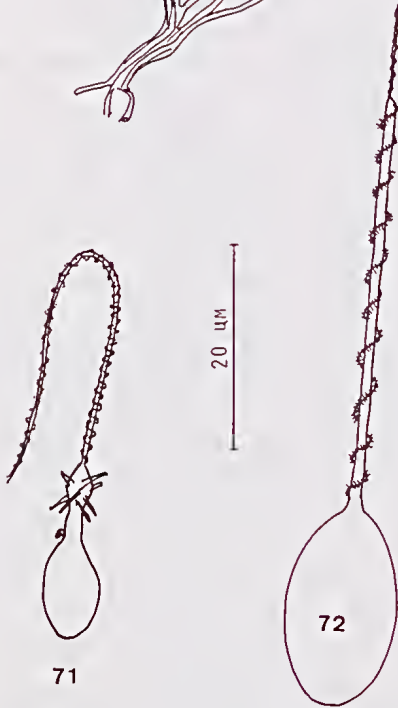
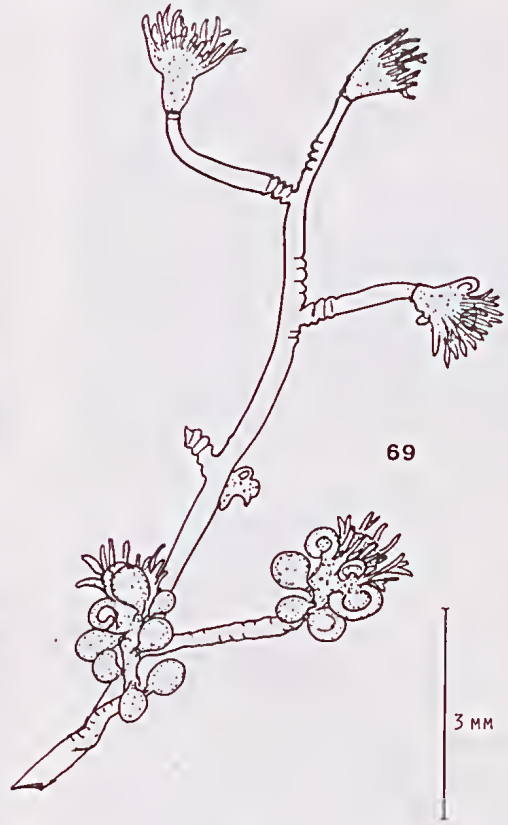
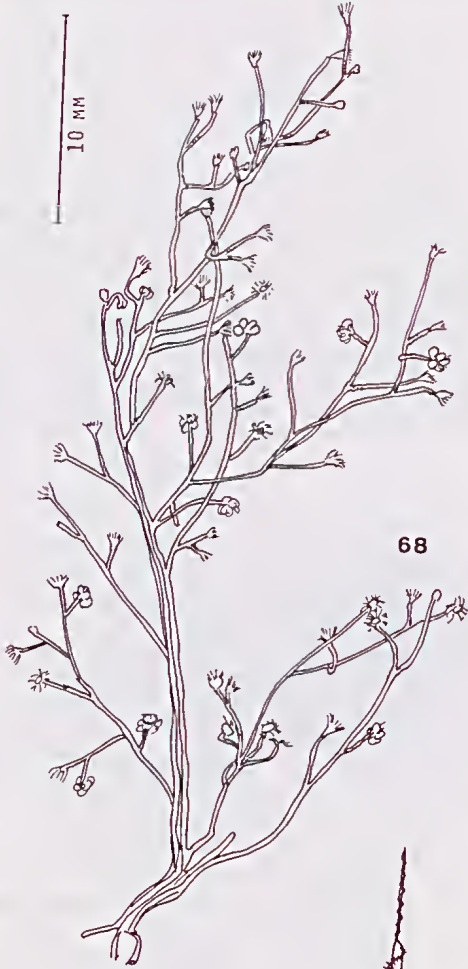
Nematocysts of two kinds present:

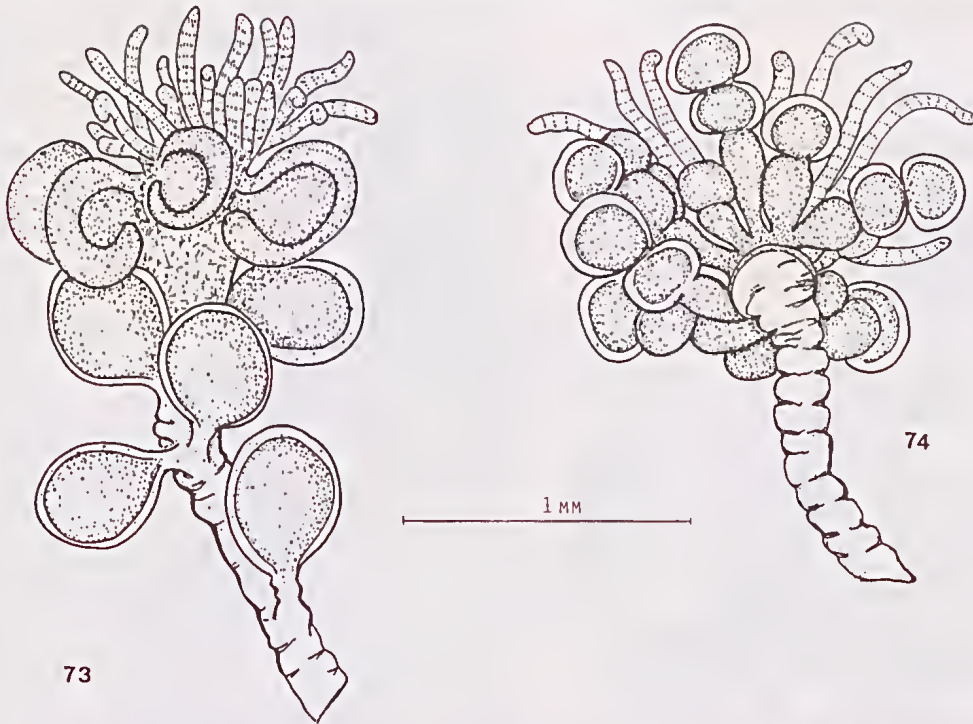
- microbasic euryteles, capsule $8-10 \times 4-5 \mu\text{m}$, shaft $7 \mu\text{m}$ long, with several large spines (Fig. 71). Very abundant in tentacles.
- microbasic mastigophores, capsule bean-shaped, $19-22 \times 10 \mu\text{m}$ long, $1.5 \mu\text{m}$ thick, thread $400 \mu\text{m}$ long, thick and spinous (Fig. 72). Moderately common on hypostome, sometimes on body of hydranth and in clusters on spadix of immature female gonophore.

MEASUREMENTS, mm: *Stem* and *branches*, max. diameter, 0.4, *Primary branches*, max. length, 10.0; *Hydranth*, max. length of pedicel, 1.5, pedicel, distal width, 0.25-0.33, max. width of body below tentacles (preserved material), 0.67, max. width across tentacles (living material), 2.5, width across body (living material), 1.0; *Gonophores*, max. length mature male scies, 0.65, diameter of mature distal chamber, 0.3-0.38, diameter of mature female, 0.45-0.5.

COLOUR: Perisarc of older stems shining dark brown, lighter in younger parts of colony. Body of hydranth orange, tentacles pink, male gonophores pearly pink, spadix deep orange; female gonophores brilliant orange. Overall colour of colony, orange to pink.

REMARKS: *Eudendrium balei* is similar in size and habit to *E. lineale* Yamada, 1954, *E. japonicum* Yamada, 1954 (known to me only from the literature), and to certain growth forms of *E. ramosum* (Linnaeus, 1758)





Figs 68-74—*Eudendrium balei* n. sp. 68, Single stem from holotype, Western Port, Vic. 69, Distal part of branch with female gonophores, from holotype. 70, Distal part of branch with male gonophores, from paratype. 71, 72, Nematocysts, drawn to same scale. 71, Microbasic curytele from tentacles. 72, Microbasic p-mastigophore from hydranth. 73, Female blastostyle from holotype with gonophores in various stages of maturity. 74, Mature male blastostyle from paratype.

(Millard 1975). The male gonophores of the first two species are, however, borne on blastostyles without tentacles, and the tentacles of the female blastostyle of *E. ramosum* are lost at maturity, not partly retained as in *E. balei*. On the other hand, Fraser (1944) figures the female blastostyle of *E. ramosum* with only partly-atrophied tentacles. Following Mariscal (1974), the supplementary nematocysts of the endome are here classified as microbasic p-mastigophores.

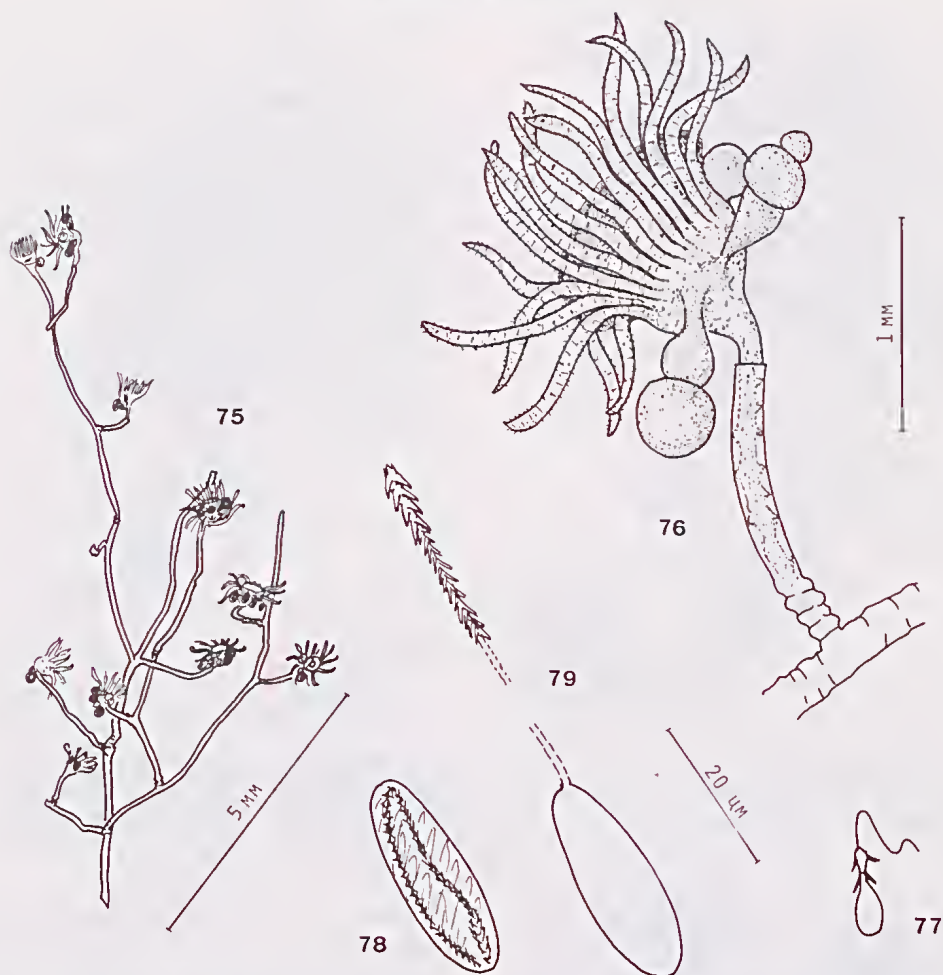
The hydroid from Port Phillip Bay, Victoria, assigned to *E. generale* von Lendenfeld, 1885 by Bale (1919) is clearly not that species but an immature female colony of *E. balei*. Bale refers to the "gland cells" on the hydranth and "nematocyst pads" on the gonophores. These occur in *E. balei* but there are no nematocyst pads on the gonophores of *E. generale*. Their occurrence in *E. balei* is usually in scattered groups rather than aggregated in pads, and only on the immature female gonophore. The microbasic mastigophores are very abundant on the hydranth, especially around the hypostome. When fully discharged, the shaft bears a spiral of fine bristles, the thread is very long and straight and it is armed with very fine, scarcely discernible bristles. *Eudendrium balei* forms large, robust and conspicuous colonies which, under favourable conditions, may grow up to 15 cm high and 20 cm wide. It is fertile from October to May (spring to early winter).

DISTRIBUTION: Known at present from Victoria (cool temperate) to the central New South Wales (warm temperate) coastline.

ETYMOLOGY: The species is named after W. M. Bale, an early authority on Australian Hydroida, who first recorded it from Port Phillip Bay.

LABORATORY OBSERVATIONS: Abundant fresh material of *E. balei* has permitted some observations on reproductive behaviour of the species. While the mature female blastostyle usually bears the same number of tentacles as the unreproductive hydranth, only half of these are ever fully extended to their normal length, each alternate tentacle being reduced to a club-shaped vestige. This type of retraction (or atrophy) of the tentacles never occurs on the sterile hydranths of the rest of the colony. Shrinkage of alternate tentacles to half the normal complement is necessary to provide space for the remaining tentacles and the developing gonophores. In contrast, tentacles of the male blastostyle never show any tendency toward reduction in number or size.

Release of planulae was also observed. The newly-released planula is 0.5 mm in length and descends from the parent colony on a mucous string in the same manner as that described in *E. generale*. Upon contact with a firm surface the planula elongates and crawls sluggishly away from the parent colony. Metamorphosis had not occurred after 48 h when observations were terminated.



Figs 75-79—*Eudendrium aylingae* n. sp. Drawn from holotype colony, Great Detached Reef, Qd. 75, Whole stem. 76, Hydranth with male gonophores. 77-79, Nematocysts, drawn to same scale. 77, Microbasic eurytele from tentacles. 78, Macrobasic eurytele, undischarged, from hypostome. 79, Macrobasic eurytele, discharged, showing overlapping distal spines on shaft.

Eudendrium aylingae n. sp.

Figs 75-79

TYPE MATERIAL AND RECORDS: Holotype, MVF50529, one male colony, formalin preserved, Great Detached Reef, Queensland, $11^{\circ} 58' S$, $143^{\circ} 58' E$ (no depth recorded); coll: A. L. Ayling (SCUBA), 22/5/79.

OTHER MATERIAL: MVF50722, microslide (Berlese mountant), Museum of Victoria Bass Strait Survey, Stn 155, 70 m, $38^{\circ} 56' S$, $145^{\circ} 16.6' E$, "Tangaroo" Cruise 81-T-1, 12/11/81. MVF50723, one male colony, alcohol preserved, Whitfords Reef, Perth, Western Australia, $31^{\circ} 55' S$, $115^{\circ} 45' E$, depth, 12 m; coll: J. E. Watson (SCUBA), 22/11/83.

DESCRIPTION OF HOLOTYPE: One colony fragment 12 mm in height, without substrate. Colony erect with no definite main stem. Branching irregular, branches straggling, with 3-4 indistinct annulations at origin and at irregular intervals throughout; stems otherwise smooth

and shining, perisarc thin. Hydranths terminal on branches or borne on irregularly-spaced pedicels, indistinctly annulated at origin. Hydranths moderately large with a wide hypostome (preserved material) and 20-22 tentacles. Male gonophores 2-chambered, up to 5 borne on a fully-developed hydranth with hypostome; at maturity the distal chamber globular or flattened, tentacles of blastostyle not reduced, or partly atrophied.

Nematocysts of two kinds present on hydranth, none on gonophores:

- small microbasic euryteles, capsule pyriform, $7 \times 3 \mu m$, shaft $5 \mu m$ long, thread fine (Fig. 77). Abundant on tentacles.
- large (?) macrobasic euryteles, capsule paddle-shaped, $28-30 \times 11-14 \mu m$, shaft very long and thick, length-width ratio 2.9:1, heavily armed with overlapping leaf-like spines, undischarged thread lying in a loose loop inside capsule (Figs 78, 79). Abundant around hypostome.

MEASUREMENTS, mm: *Stem* and *branches*, max. width, 0.18, *Branch*, proximal width, 0.075-0.13; *Pedicel*, (or branch) length, 1.0-2.0, distal width, 0.1-0.13; *Hydranth* (preserved material) width below tentacles, 0.4-0.5; *Male gonophore*, length, 0.33-0.38, diameter of distal chamber, 0.25.

COLOUR: Perisarc pale honey brown, colour of living hydranths unknown.

REMARKS: The enidome of *E. aylingae* resembles that of another tropical species, *E. infundibuliforme* Kirkpatrick, 1890, in the presence of large macrobasal euryteles around the hypostome. However, these nematocysts differ from those of *E. infundibuliforme* in both the shape of the capsule and morphology of the shaft. Those of *E. aylingae* possess a very long, distally-swollen shaft; no threads were observed. In the few fully-discharged specimens available for study, the entire length of the shaft is covered by overlapping leaf-shaped spines. These spines point forward in the undischarged state, then reverse to the normal backward-facing direction upon complete discharge. The nematocysts are remarkably like those figured and described by Kirkpatrick (1890) from *Cladocoryne haddoni* from Torres Strait. Although the type material is meagre, I have no hesitation in regarding this as a new species, clearly identifiable by the unusual enidome.

The material from Perth, Western Australia, comprises a small, sparingly-fertile male colony with 2-chambered gonophores. Although the stems are small and straggling, similar to the holotype, the colony itself is somewhat more robust. The Bass Strait specimen comprises only a single hydranth with male gonophore buds. While the material of both specimens is inadequate for firm identification, the enidome of each is sufficiently like that of *E. aylingae* for them to be provisionally referred to this species. Although undischarged in both Western Australian and Bass Strait specimens, the hypostomal nematocysts are clearly macrobasal euryteles, the typically heavily-armed shaft lying in a loose coil along the walls of the capsule. The thread appears to be very long and fine. Dimensions of the nematocysts of both the Western Australian and Bass Strait specimens are given for comparison.

The Bass Strait record is the deepest record of *Eudendrium* from the Australian coastline.

MEASUREMENTS, μ m:

	Tentacular microbasal euryteles		Hypostomal macrobasal euryteles
	capsule	shaft	
Bass Strait	9	—	27-30
(MVF50722)	× 3-3.5		× 9-10 L/W ratio, 2.8
W. Australia	8-9		× 35-36
(MVF50723)	× 3-4	7 × 2	× 13-15 L/W ratio, 2.8

ETYMOLOGY: The species is named for Avril Ayling, who collected the type material on the Great Barrier Reef, Queensland.

Eudendrium currumbense n. sp.

Figs 80-83

Eudendrium capillare Alder, 1856. Pennyuik, 1959: 168 (in part).

Pennyuik (1959, p. 168) provisionally assigned her material from Currumbin, Queensland, to *E. capillare* Alder, 1856, rather than to the superficially similar *E. generale* von Lendenfeld, 1885. Her identification rested partly on unreliable morphological features such as height and branching of the colony. Examination of the enidome of Pennyuik's material shows it to be neither of these species. It is here regarded as a new species, described below.

TYPE MATERIAL AND RECORDS: Holotype, QMG5510, one sterile colony, alcohol preserved, on sponge in rock pool, Currumbin, Queensland, 28° 16' S, 153° 26' E; coll: P. Pennyuik, 1/7/51.

OTHER MATERIAL: One sterile colony on weed, 5 km NE of Bundaberg Light, Queensland, 24° 52' S, 152° 48' E, Agassiz trawl; coll: M. Blackburn, 14/9/38.

DESCRIPTION OF HOLOTYPE: Colony sterile, comprising several stems growing through the sponge tissue. Stems up to 6 mm in height, unfeathered, slender, irregularly branched, branches twisted and bent, a few indefinite annulations at origin and at intervals along the branch and sometimes below the hydranth. Hydranths small, with 20-24 tentacles.

Nematocysts of two kinds present:

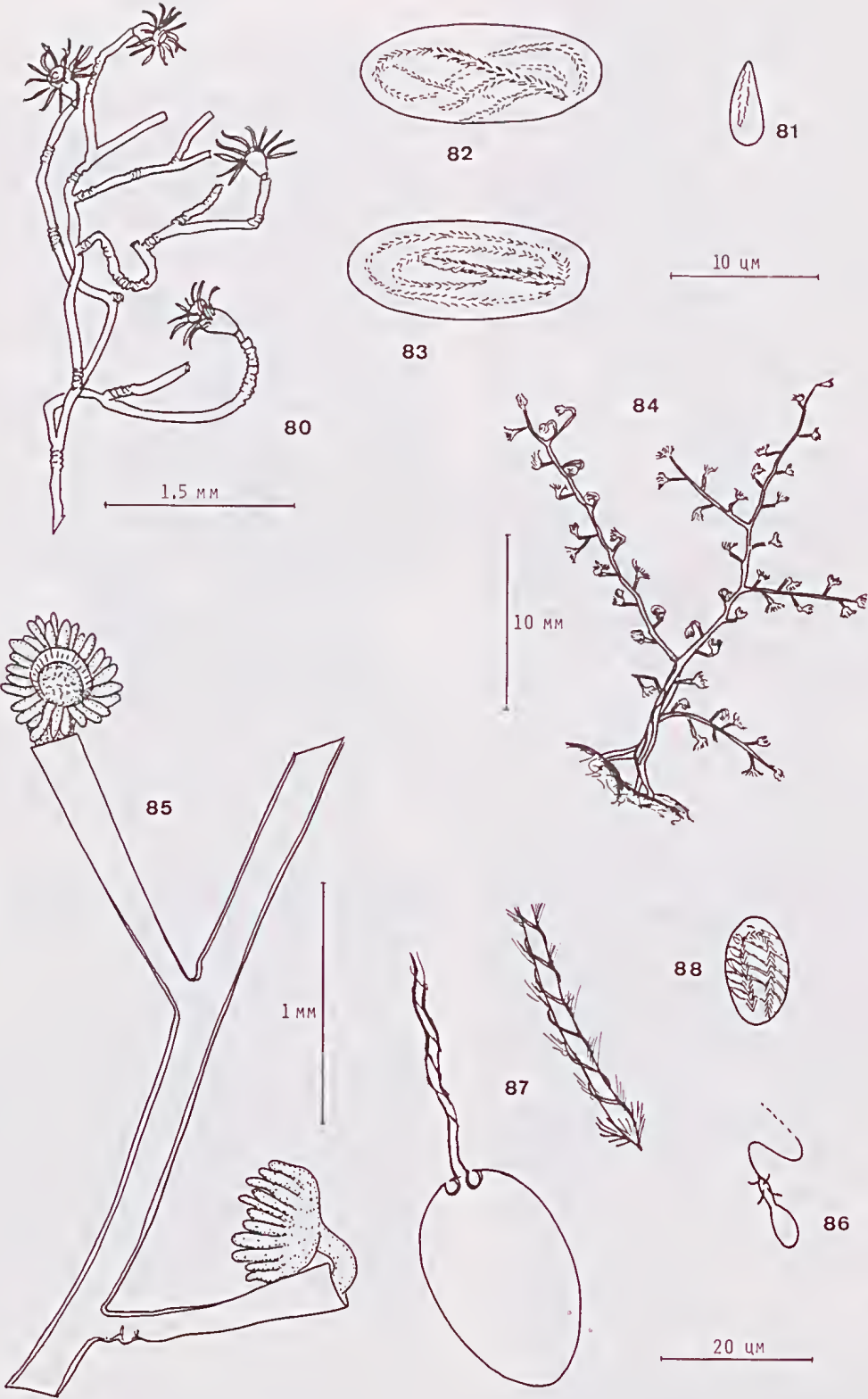
- small microbasal euryteles, capsule pyriform, 6 × 2.5-3 μ m, none discharged, undischarged shaft lying slightly oblique to long axis of capsule (Fig. 81). Abundant in tentacles.
- (?)macrobasal euryteles, 16-19 × 6-8 μ m, length-width ratio 2.5:1, shaft not well preserved in those discharged, undischarged shaft lying in 4-5 loose figure of eight coils in capsule or in coils parallel to capsule walls, depending upon the angle of view (Figs 82, 83). A few scattered on hydranth and on the hypostome.

MEASUREMENTS, mm, [including those of Pennyuik (1959)]; *Pedicel*, width below hydranth, 0.09-0.12; *Hydranth* (preserved material), length, base to hypostome, 0.23-0.54, width below tentacles, 0.15-0.25, width across extended tentacles, 0.17-0.33, length of tentacles, 0.23-0.46.

COLOUR: Proximal stems honey brown, becoming paler distally. Colour of living hydranth unknown.

REMARKS: In the collection of the Queensland Museum there is a small, very poorly-preserved colony of *Eudendrium* from Bundaberg, Queensland. The enidome of this specimen shows it probably to be *E. currumbense*. While the sterile colony of *E. currumbense* is virtually indistinguishable from other small species such as *E. capillare*, *E. nambuccense* and *E. pennycuikae*, the presence of heteronemes in the enidome readily separates it from these species.

ETYMOLOGY: The species name refers to the type locality.



Eudendrium infundibuliforme Kirkpatrick, 1890

Figs 84-88

Eudendrium infundibuliforme Kirkpatrick, 1890; 606, Pl. 14, Fig. 3. Pennycook, 1959: 167. Rösler, 1978: 96, Pl. 17, Figs 3-5.

MATERIAL AND RECORDS: Holotype, BM1890.7.23.3, Stn 2, 10 m deep, 32 km NNW of Warrior Island, Torres Strait (Kirkpatrick). MVF50501 sterile colony, formalin preserved, Basilisk Passage, depth 10 m, Port Moresby, Papua New Guinea, 9° 30' S, 147° 10' E; coll: J. E. Watson (SCUBA), November, 1979. MVF50502, male colony, formalin preserved, Carter Reef, Queensland 14° 32' S, 145° 35' E; depth, 15 m; coll: A. L. Ayling (SCUBA), 16/3/83. MVF50528, sterile colony, formalin preserved, Great Detached Reef, Queensland 11° 58' S, 143° 58' E; coll: A. L. Ayling (SCUBA) (no depth), 22/5/79.

DESCRIPTION: It has not been necessary to examine the type material of *E. infundibuliforme* since this is one of the few Australian species easily identifiable on colony characters alone. The following description supplements that of Kirkpatrick. The present specimens are erect, arborescent colonies from 3-8 cm in height. The main stems are straight, or gnarled and twisted, strongly fasciated, arising from a thick rootstock, the fascicular tubes running halfway up the main stem and along the proximal region of the main branches. Branching sparse, more or less in one plane, irregularly alternate, some secondary branching present. Perisare of main stems indistinctly ringed at intervals, branches with 3-4 proximal annulations, perisare otherwise smooth and shining.

Hydranth pedicels regularly alternate, with 2-5 obscure proximal annulations, or wrinkled throughout. Hydranths large, with up to 30 tentacles and a wide hypostome (preserved material). The male specimen from Carter Reef is sparingly fertile, gonophores 2 or 3-chambered, one or two borne on a fully-developed hydranth with hypostome. Immature distal chamber slightly elongate with a distinct apical peak, lost at maturity; mature chamber bead-shaped.

Nematocysts of two kinds present in all specimens:

- small microbasal euryteles, capsule $6 \times 3 \mu\text{m}$, shaft $5 \mu\text{m}$ long, with a few prominent spines (Fig. 86). Abundant in tentacles.
- very large holotrichous macrobasal euryteles, capsule egg-shaped, $30-34 \times 18-22 \mu\text{m}$; shaft $400 \mu\text{m}$ long, slightly expanded at tip, armed with spirals of bristles over entire length and with additional

larger bristles in the distal region (Fig. 87). Abundant around hypostome.

A third kind of nematocyst is present, although rare, in all specimens except those from Carter Reef. These are small ?macrobasal euryteles, capsule egg-shaped, $12 \times 8 \mu\text{m}$, (none discharged), site on hydranth unknown (Fig. 88).

MEASUREMENTS, mm: *Stem*, proximal width, 0.6-2.25; *Branch*, proximal width, 0.1-0.35; *Pedicel*, proximal width, 0.08-0.15, distal width, 0.18-0.33, length, 0.8-1.63; *Hydranth*, (preserved material), width below tentacles, 0.38-0.7; *Male gonophore*, diameter of distal chamber, 0.2.

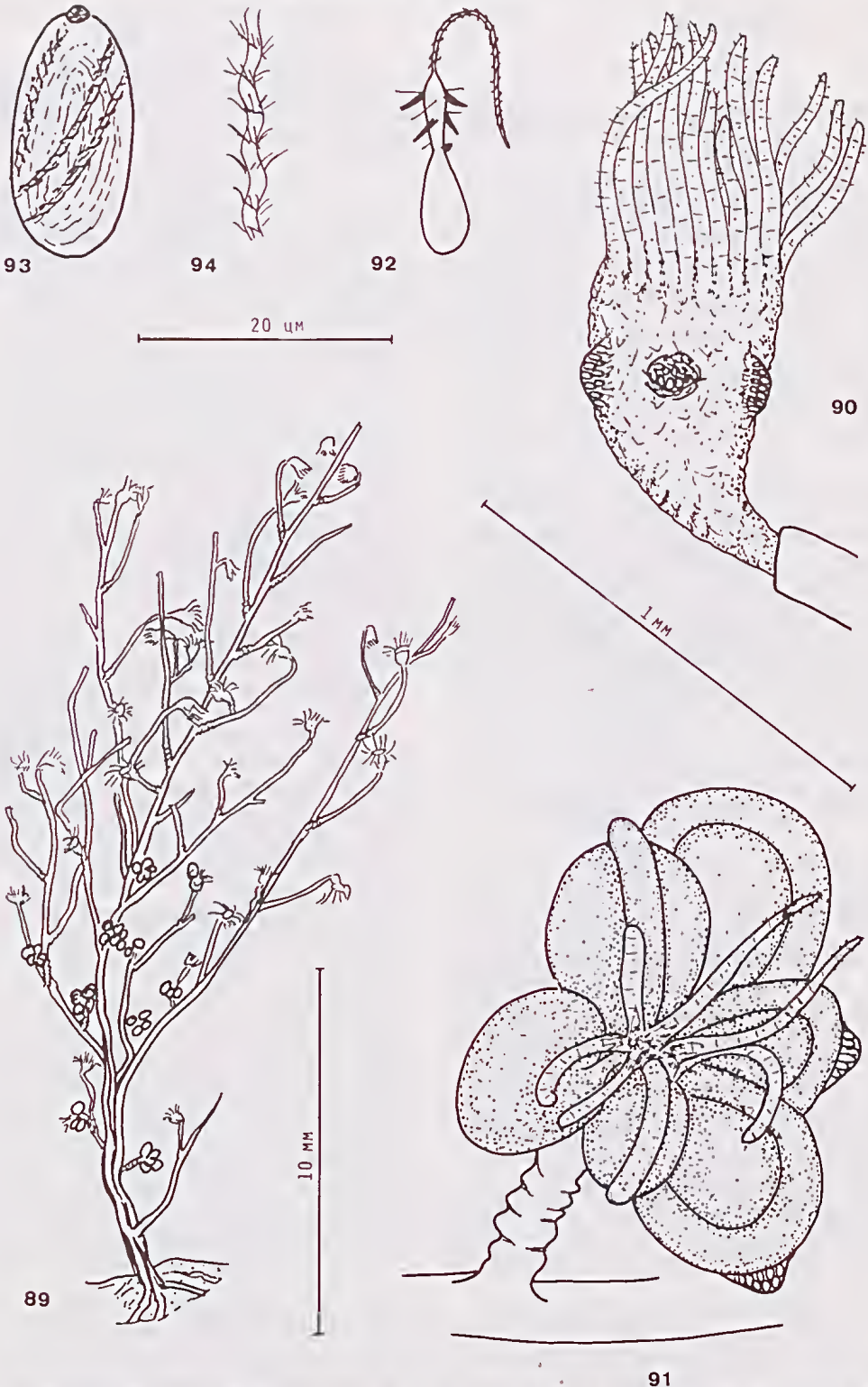
COLOUR: Older stems deep brown, grading to lighter brown on younger parts. Living hydranths deep yellow. **REMARKS:** *Eudendrium infundibuliforme* is an easily recognisable species by its robust, arborescent habit, distally-expanding, hydranth pedicels, and especially by the endome. Kirkpatrick (1890) remarked upon the "large peduncular portion between the end of the perisare and the base of the tentacles". Elongation of the hydranth is usually a chance artefact of preservation in most species of *Eudendrium* and is therefore regarded as being of little diagnostic value. It is, however, such a very constant feature in both living and preserved specimens of *E. infundibuliforme* that it can justifiably be regarded as being characteristic of the species.

Rösler (1978) doubted the validity of Kirkpatrick's reference of the Torres Strait specimens to *Eudendrium* on the assumption that a distally-widening, hydrothecal pedicel is neither typical of the genus, nor even of the Athecata. This shape of pedicel is not, however, unique among the Athecata, since it is also present in the genus *Merona* (F. Clavidae) (see Watson 1978). Moreover, the abundant material of *E. infundibuliforme* available to the present study demonstrates conclusively through colony morphology, reproductive structures and the endome that this hydroid is clearly a species of *Eudendrium*.

As Kirkpatrick's material was sterile, the Queensland specimen provides the first record of the reproductive structures of the species. Unfortunately, the sparingly fertile material is inadequate to determine whether the few male gonophores borne below the hydranth are a number normal for the species. The very large hypostomal nematocysts are a distinctive feature. Although I have been unable to isolate a thread for examination, these nematocysts are considered, following Werner (1965), to be holotrichous macrobasal euryteles. The third, rare nematocyst present in the majority of

Figs 80-83—*Eudendrium currumbense* n. sp. Drawn from holotype, Currumbin, Qd. 80, Stem. 81-83, Nematocysts, drawn to same scale. 81, Microbasal eurytele from tentacles, undischarged. 82, 83, Undischarged macrobasal euryteles from hydranth, viewed from two aspects. 82, showing apparently obliquely-coiled shaft. 83, showing apparently spirally-coiled shaft.

Figs 84-88—*Eudendrium infundibuliforme* Kirkpatrick, 1890. 84, Colony from Carter Reef, Qd. 85, Part of branch from specimen from Port Moresby, Papua New Guinea. 86-88, Nematocysts, drawn to same scale. 86, Microbasal eurytele from tentacles, discharged. 87, Large macrobasal eurytele from hypostome, proximal and distal regions of shaft shown. 88, Smaller ?macrobasal eurytele, undischarged, in specimen from Port Moresby.



Figs 89-94—*Eudendrium glomeratum* Picard, 1951. Specimen from Cape Jaubert, W.A., assigned by Jäderholm (1916) to *E. pusillum* von Lendenfeld, 1885. 89, Whole colony. 90, Hydranth, showing button-shaped nematocyst pads. 91, Female blastostyle with gonophores at several stages of maturity; nematocyst pads on spadix of young gonophores. 92-94, Nematocysts, drawn to same scale. 92, Microbasal eurytele from tentacles. 93, ?Macrobasal eurytele, undischarged, from nematocyst pad on hydranth. 94, part of discharged shaft of ?macrobasal eurytele showing spirals of fine bristles.

specimens is very similar to the larger macrobasic euryteles of the hypostome.

DISTRIBUTION: *Eudendrium infundibuliforme* has been previously known only from the type locality in Torres Strait. The present records extend its known range further north to Papua New Guinea and south along the Great Barrier Reef. It may eventually prove to be a common hydroid of deeper tropical waters.

Eudendrium glomeratum Picard, 1951

Figs 89-94

Eudendrium glomeratum Picard, 1951: 338; 1955: 183.

Rossi, 1961: 73. Teissier, 1965: 14. Fey, 1969: 391.

Rösler, 1978: 88, Pl. 14, Fig. 6.

Eudendrium pusillum von Lendenfeld, 1885: 352.

Thornely, 1904: 110, Pl. 1, Fig. 5. Jäderholm, 1916: 3.

?*Eudendrium indopacificum* Stechow, 1923: 59.

Eudendrium ramosum (Linnaeus, 1758). Motz-Kossowska, 1905: 54, Pl. 3, Fig. 16.

MATERIAL AND RECORD: Swedish Museum of Natural History No. 498, one female colony, alcohol preserved, 72 km WSW of Cape Jaubert, Western Australia, 18° 56' S, 121° 39' E, depth 99 m; coll: Swedish Scientific Expedition to Australia 1910-1913, 6/7/11.

Thornely (1904) referred a specimen from the Gulf of Manaar, Sri Lanka, to *Eudendrium pusillum* von Lendenfeld, 1885. On the basis of its resemblance to Thornely's figure, Jäderholm (1916) also referred a specimen from Cape Jaubert, north-western Australia, to *E. pusillum*. Briggs (1922) expressed the opinion that Thornely's specimen was not *E. pusillum* although he did not propose a new name. At the same time he substituted the name *E. lendenfeldi* for *E. pusillum* on the grounds of pre-occupation of the latter name. Stechow (1923) then proposed a new name, *E. indopacificum*, for Thornely's and Jäderholm's specimens, apparently without examination of their material.

I have been unable to trace Thornely's specimen and agree with Rösler (1978), that it must be presumed lost. Through courtesy of the Swedish Museum of Natural History I have been able to examine Jäderholm's specimen and compare it with a female colony of *E. glomeratum* Picard, 1951 from the Gulf of Genova, loaned by the British Museum (Natural History). The specimens are virtually identical in colony morphology and in characters of the cnidome. Only a few nematocysts in the Australian material are discharged and these are in poor condition; the supplementary nematocysts of the cnidome appear to be macrobasic euryteles which, in size and coiling of the shaft, agree closely with those of *E. glomeratum*. Although Picard (1951) describes the nematocysts of *E. glomeratum* as being arranged in projecting buttons around the lower hydranth body, the specimen from the Gulf of Genova displays a number of configurations varying from an uninterrupted nematocyst ring around the hydranth to discrete groups arranged in a digitate pattern scattered around the body of the hydranth.

Rösler (1978) mentions the similarity of both form and cnidome of *E. glomeratum* and *E. ramosum*. This has, apparently, led to misidentification in the past, since recent critical re-examination of the holdings of *E. ramosum* in the British Museum (Natural History) has revealed some specimens from England and Ireland to be *E. glomeratum* (Cornelius & Boero pers. comm.). The two species from Australia as known at present are, however, easily differentiated by colony form, *E. glomeratum* being arborescent while colonies of *E. ramosum* are straggling, although robust in habit. The following redescription of *E. glomeratum* from Australia includes that of Jäderholm (1916).

DESCRIPTION: The specimen is a mature female colony 30 mm in height comprising a single stem growing from a rootstock embedded in sponge. The main stem is almost straight and the lower third is lightly fasciated. With one exception, the branches are unfasciated. The branches are given off from around the main stem in roughly three planes, upwardly directed, rebranching common, 3-6 annulations at origin, perisarc smooth and shining throughout. Hydranths terminal on branches, moderately large, with 24-28 tentacles, body of 50% of the hydranths with 3-5 prominent button-shaped nematocyst pads in the proximal region. Female gonophores in various stages of maturity are borne in a cluster of 4-6 on the body of the hydranth, spadix of immature gonophore unbranched, with a distal nematocyst pad, lost at maturity. Mature blastostyle with either a normal number of tentacles or a reduced number of 6-8 partly-atrophied tentacles as described by Jäderholm. Mature gonophore elongate, enclosed in a thin pellicle, retained in original position on hydranth or slightly displaced down the blastostyle.

Nematocysts of two kinds present:

- microbasic euryteles, 7-8 × 3-4 μm, shaft 4-6 μm long, broad, with prominent spines and bristles, thread rosy (Fig. 92). Abundant in tentacles. Length-width ratio, 2:1.
- large (?) macrobasic euryteles, capsule bean-shaped, ends blunt, 19-22 × 9-10 μm, few discharged, length-width ratio 2.3:1. Distal part of shaft thick and armed with bristles, undischarged shaft lying in one or two loosely oblique coils inside capsule (Fig. 93). Very abundant in the nematocyst pads on hydranths and on the gonophores.

MEASUREMENTS, (mm): *Stem*, proximal width, 0.1; *Branches*, max. length, 7.4, width at origin, 0.13-0.18, width below hydranth, 0.13-0.18; *Pedicel*, length, 1.5-3.0; *Hydranth* (preserved material), width below tentacles, 0.23-0.38; *Gonophores*, width of cluster, 0.75-0.95, length of mature gonophore, 0.3-0.38.

DISTRIBUTION: Mediterranean Sea (Picard 1951), north-western France (Teissier 1965, Fey 1969) England, Ireland (Cornelius & Boero pers. comm.) and north-western Australia.

DISTRIBUTION AND ECOLOGY

DISTRIBUTION: The genus *Eudendrium* is now recorded from about half of the Australian coastline, encompassing the tropical waters of the Great Barrier Reef and Torres Strait from 11° S to cool temperate Bass Strait at 38° S and the Pacific coast in the east to the Indian Ocean in Western Australia (Fig. 95). There are, however, large gaps in the record, namely those of the northern coastline and Timor Sea, the shores of the east Indian Ocean in Western Australia, the Great Australian Bight and the Tasmanian region. The sparseness of the record from most of these regions probably reflects the difficulty of access and lack of collecting intensity rather than any impoverishment of the *Eudendrium* fauna. The absence of records from the Great Australian Bight, particularly the eastern Bight in South Australia, and from Tasmania, is, however, noteworthy, since localities in these regions have been intensively collected by the author and others on several occasions. The patchiness of the record in some of these

areas may therefore be partly attributable to distributional patterns, indicating some avoidance by *Eudendrium* of clearer oceanic waters. Avoidance of high light intensity by *E. ramosum* on the coral reefs of the West Indies and the Red Sea has been pointed out by Mergner (1972, 1977).

The zoogeographic record (Table 1) suggests a relatively endemic *Eudendrium* fauna, there being only one out of the seventeen species recorded, *E. aylingae*, occurring in three biogeographic provinces, the tropical Solanderian, subtropical Damperian and cool temperate Flindersian. The Flindersian record is, however, somewhat doubtful owing to paucity of material. Although it might be expected that the cosmopolitan *E. capillare* should occur through all Australian biogeographic provinces, the only reasonably certain record so far is from the temperate Peronian together with a doubtful record from the Solanderian. Although probably world-wide in distribution, *E. capillare*, as shown for Australian material in this study, has in the past been confused with other species. There is a great

TABLE 1 DISTRIBUTION OF *Eudendrium* SPECIES RECORDED FROM AUSTRALIA

Species	SOLAN- DERIAN	PERO- NIAN	FLIND- ERSIAN	DAMPER- IAN	Other Regions
	N. Great Barrier Reef Southern Queensland N. New South Wales Central New South Wales S. New South Wales Eastern Bass Strait Central Bass Strait South W. Australia Central W. Australia North W. Australia				
1. <i>E. minutum</i>				p	
2. <i>E. pennycuikae</i>	p				
3. <i>E. nambuc- cense</i>		p		p	
4. <i>E. capillare</i>	?p	p			Cosmopolitan Northern New Zealand
5. <i>E. terranovae</i>				p	
6. <i>E. corrugatum</i>	p				
7. <i>E. ramosum</i>	p			p	Britain, North Atlantic, Mediterranean, Seychelles, South Africa.
8. <i>E. kirkpatricki</i>	p				p Papua New Guinea.
9. <i>E. generale</i>		p	p	p	?South China Sea.
10. <i>E. merulum</i>	p		p		
11. <i>E. carneum</i>				p	N and S America, Bermuda, St. Helena, South Africa.
12. <i>E. racemosum</i>	p	p			Mediterranean, South China Sea, Japan, Seychelles.
13. <i>E. balei</i>		p	p	p	
14. <i>E. aylingae</i>	p			p	p
15. <i>E. currumbense</i>	p				
16. <i>E. infun- dibuliforme</i>	p				
17. <i>E. glomeratum</i>					p Papua New Guinea. Mediterranean, north- western France, England, Ireland.

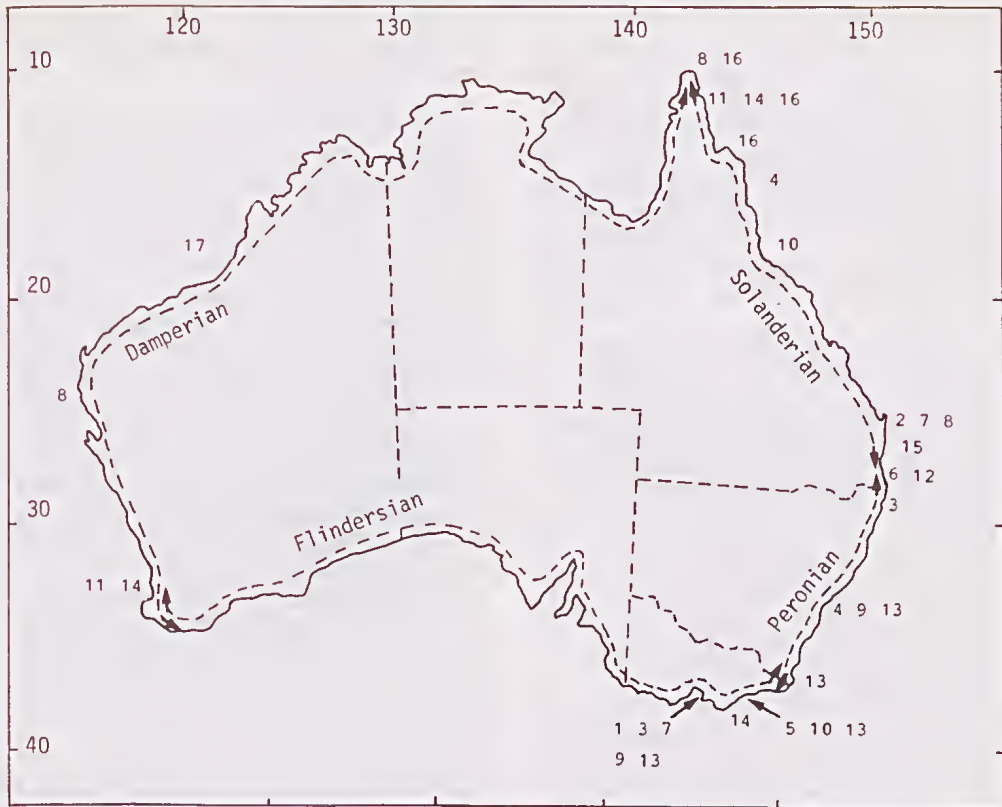


Fig. 95—Distribution of the *Eudendrium* fauna of Australia. Map shows coastal biogeographic provinces. Numbers refer to species listed in key order.

need for a critical world revision to place this species, as well as many other species of *Eudendrium*, in their proper systematic and distribution contexts.

Eight species are recorded from two Australian provinces and eight from only one province. Those recorded from adjacent provinces are *E. nambuccense*, *E. generale* and *E. balei*, all of which range from the warm temperate northern extreme of the Peronian to the Flindersian province of the east coast (Fig. 95). Two species, *E. ramosum* and *E. merulum*, are so far recorded from two widely-separated provinces without records from the intervening regions. *Eudendrium ramosum* is recorded near the boundary of the Solanderian and Peronian in southern Queensland, its range also extending south into Bass Strait, while *E. merulum* is recorded from the northern Great Barrier Reef and eastern Bass Strait. Although widely separated by some 3,500 km of coastline, the biogeographic distance between records of *E. kirkpatricki* is not significant, since summer water temperatures in Shark Bay in the Dampierian province of Western Australia approach those of the tropical Great Barrier Reef.

Of the eight species recorded from one province only, three, *E. pennycuikae*, *E. corrugatum*, and *E. currumbense*, occur near the Solanderian-Peronian boundary in southern Queensland. There are no records of species endemic to the Peronian, while two species, *E.*

minutum and *E. terranova*, are recorded only from the cooler Flindersian of Bass Strait.

The present biogeographic record suggests a highly endemic Australian *Eudendrium* fauna. Of the seventeen species recorded here, only five (29%), are known from outside the Australian region. Of these, *E. capillare* is cosmopolitan, *E. carnenum* ranges from the east coast of South America (Vannucci 1954, Wedler 1975), the Caribbean (Vervoort 1968), the Atlantic coast of North America (Clarke 1882), to parts of the southern hemisphere including the east coast of South Africa (Millard 1975). *Eudendrium racemosum* is known from the Mediterranean Sea (Mergner 1957), the South China Sea (Leloup 1937), the north-western Pacific (Hirohito 1969), and the western Indian Ocean (Millard & Bouillon 1973); *E. ramosum* is widely distributed in the North Atlantic, although some of the records are doubtful (Millard 1975), the Mediterranean Sea (Picard 1955), the Red Sea (Mergner 1977), the western Indian Ocean (Millard 1975) and the West Indies (Mergner 1975); *E. glomeratum* has been recorded from the Mediterranean Sea (Picard 1951), north-western France (Teissier 1965, Fey 1969), and recently, the coast of England and Ireland (Cornelius & Boero pers. comm.).

The range of two species, *E. kirkpatricki* and *E. infundibuliforme*, is now extended northward to Papua

New Guinea. *Eudendrium terranova* is the only species recorded in this study common to Australia and New Zealand. This is surprising, considering the overall similarity of the trans-Tasman thecate hydroid fauna. Future collecting around New Zealand might reveal more species common to both regions.

The only record of an Australian species from outside the Australian region is that of *E. generale* var. *amoyicum* from the South China Sea (Hargitt 1927, Ling 1938). However, this record is here considered doubtful and needs verification from examination of fresh material (p.200).

The *Eudendrium* fauna of the seas surrounding the Australian region is so poorly known, and in many instances the taxonomy so unreliable, that there is little value in making regional biogeographical comparisons. South Africa is the only adjacent southern hemisphere region for which there is any useful information. Millard (1975) recognised eight species from southern Africa, only two of which, *E. capillare* and *E. carneum*, are so far known to occur in Australia. Stepanjants (1979) recognised three species from the Antarctic, but only the circumpolar *E. antarcticum* Stechow, 1921, occurs in the region south of Australia. This species has not, however, been recorded in the present study.

The record suggests that *Eudendrium* may be a shelf genus in Australia, inhabiting relatively shallow waters ranging from the intertidal zone (*E. currumbense*) to depths of 70 m (*E. aylingae*) and 99 m (*E. glomeratum*). The shallow bathymetric ranges recorded for most of the species is undoubtedly an artefact of the depths readily accessible to small dredges and SCUBA, by which means the major part of the present collection was made. The record may thus not reflect any marked preference of the genus for the continental shelf. Nonetheless, world-wide, deep-water records of *Eudendrium* are comparatively rare, some of the deepest being: *E. antarcticum* Stechow, 1921, from 650 m in the Kerguelen Islands (Millard 1977); *E. rameum* Pallas, 1766 from 191 m, also in the Kerguelens (Allman 1888); *E. rameum* from 310 m off the Hawaiian Islands (Nutting 1905); and *E. deciduum* and *E. ramosum* from 174 m and 220 m respectively in the Red Sea (Mergner & Wedler 1977). The deepest record of any species of *Eudendrium* is that of 1,267 m off Newfoundland (Pictet & Bedot 1900).

ECOLOGY: Field observations by the author and others indicate choice of a rather narrow range of habitat by many species of *Eudendrium*. Most of the species collected by the author in this study have been found in habitat of low light intensity, such as shaded or cryptic situations, similar to preferences of *Eudendrium* reported by Wedler (1975), Mergner (1977), and Mergner and Wedler (1977). Colonies of some species, for example, *E. balei* and *E. generale*, exhibit their most luxuriant development over a narrow band of irradiance, suggesting that light intensity may be a controlling factor in their distribution with depth. The observations of Light (1913) on the presence of zooxanthellae in the hydranth of *E. griffini* (= *Myrionema*

griffini) is of interest in this regard, suggesting that bathymetric distribution and choice of habitat by *Eudendrium* may be dictated to some extent by symbiotic relationships.

Underwater observations by the author show that the Australian species of *Eudendrium* avoid turbulent water movement such as breaking waves, which are likely to destroy the unprotected hydranths. Stolonal colonies with straggling, unfasciated stems or only lightly-fasciated stems, for example, *E. generale*, *E. ramosum* and *E. merulum*, occur in places where oscillatory water movement such as "edge effects" (Foster 1975) are dominant. The flexibility of these colonies probably allows utilisation of habitats that would be too rigorous for species with more rigid stems. The most luxuriant colonies of robust, bushy species such as *E. balei* and *E. ramosum*, seen by the author, occur in the swift-flowing, tide-channels of Western Port and at Port Phillip Heads, Victoria. The large size attained by these colonies is probably a reflection of the abundant food supply borne on currents which often exceed 200 cm sec⁻¹. Preference of two species, *E. racemosum* and *E. carneum*, for reef habitat with good current flow has been noted by Wedler (1975), Mergner (1977) and Mergner and Wedler (1977). These species have also been found occupying similar habitats in the present study.

Taller, arborescent colonies, such as *E. terranova* and *E. infundibuliforme*, which have stiff, fasciated stems, seldom occur in open situations, preferring the sheltered habitat of small caverns and overhangs in relatively shallow ocean water. In these situations, an arborescent or fan-shaped colony forms a web which can be oriented more or less normal to the micro-patterns of water movement, thus maximising efficiency in capture of food.

Observations on the species of *Eudendrium* in Australia do not indicate that they display any marked preference for particular substrates. Most are epizootic, occurring on sponges, compound ascidians, bryozoans, brachiopods and bivalves, and sometimes on other cnidarians. Under favourable conditions, some of the smaller species, for example, *E. merulum*, *E. capillare* and *E. generale*, may form dense hydroid meadows on the substrate. Stolonal species sometimes occur as epiphytes on marine plants, for example, *E. pennycuikae* on the seagrass *Halophila spinulosa*; *E. capillare* on the brown alga *Hormosira banksii*; and, simple stems of *E. terranova* on the green alga *Caulerpa flexilis*.

The strongly colonial habit of many species may well be a consequence of rapid settlement of the short-lived planula larva near the parent colony (Wasserthal & Wasserthal 1973). Gregarious settlement during the short larval stage also occurs in this manner among certain nemertean (Hughes 1977) and tubularian hydroids (Watson 1980). It has the advantage of strengthening the colony through addition of numerous fascicular tubes as well as giving protection to young hydranths immersed among the stems of the colony. These settle-

ment patterns are probably the reason for the downwardly-growing fascicular tubes characteristic of the large colonies of *E. carneum* observed at Fremantle, Western Australia.

Some information is available on the life cycle of certain species of *Eudendrium* (Vannucci 1954, Vervoort 1946, Wasserthal & Wasserthal 1973), but little is known about the longevity of individual colonies other than observations of *E. carneum* by Wedler (1975). Underwater observations on *E. balei* at Crawfish Rock, Western Port, Victoria, have shown that some colonies have occupied the same place for at least five years (pers. obs.). Growth commences from the moribund hydrorhizal filaments embedded in compound ascidian or sponge in late winter to spring. The colonies become reproductive during higher water temperatures over the summer months then die off as temperatures drop with the approach of winter. Longevity seems to be determined more by the stability and longevity of the substrate species rather than by ageing of the hydroid colony itself.

With large hydranths and exposed, yolk-rich ova (Mergner 1974), colonies of *Eudendrium* are highly vulnerable to predation. Observations in this study have shown that some species of *Eudendrium* are heavily preyed upon by pycnogonids and nudibranchs, and some are occasionally grazed by small fish. Pycnogonid larvae at the protonymphon stage have been observed in laboratory studies, feeding upon *E. ramosum* from Port Phillip Heads. Adults of *Nymphon aquidigitatum* Haswell have also been observed in Western Port over the summer months, feeding upon colonies of *E. balei*.

Associations of nudibranchs with *Eudendrium* are also of very common occurrence in southern Australian waters. Hydranths and ova of most of the species of *Eudendrium* collected by the author, are grazed by small, brightly-coloured aeolid nudibranchs, mainly of the genera *Flabellina* and *Coryphella*, as well as by *Doto ostenta* Burn. The nudibranchs may spend some, or all, of their life cycles on the hydroid colonies, grazing the hydranths and gonophores and laying egg ribbons among the branches. Often, it is possible to provisionally determine the hydroid host species from examination of the nematocysts retained in the cerrata of the aeolid.

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